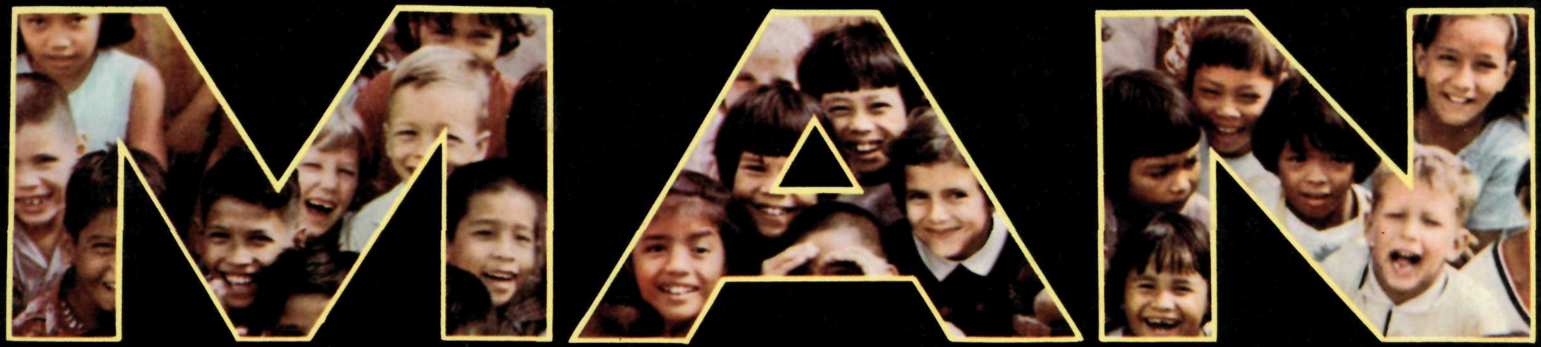

MAN

... an endangered species?

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... an endangered species?

UNITED STATES DEPARTMENT OF THE INTERIOR CONSERVATION YEARBOOK No. 4

Atlantic Richfield Co.—"Automobile Adventures" Magazine— Photo by Woodbridge Williams

Foreword

There is an insidious logic that implies that men must adapt to machines, not machines to men; that production, speed, novelty, progress at any price must come first, and people second; that mechanization may be pushed as far as human endurance will allow.

It ignores experience—which tells us we should not add new strains and pressures and discomforts to a high-pressure world.

Certain brilliant men are so engrossed in engineering techniques that they have seemingly lost sight of their own species.

Our goal should be to accomplish both full production and the full life . . . a national prosperity that will include prosperity of the human spirit.

Gross National Product is our Holy Grail; the economists and statisticians its keepers. Statistics concerning auto output, steel production, heavy construction, housing starts, freight-car loadings have become the indices of the American advance.

We have no environmental index, no census statistics to measure whether the country is more or less livable from year to year.

A tranquility index, a cleanliness index, a privacy index, might have told us something about the condition of man, but a fast-growing country bent on piling up material things has been indifferent to the "little things" that add joy to everyday living.

In 1967, despite the amazing advances of science, the approach to our overall world effort at human betterment is most unscientific. We have long since perfected the concept of the land's carrying capacity for animals, and we practice the principle of sustained yield in the management of trees and plants. Yet we abandon the idea of natural balance when we come to our own species.

We have mastered the arts of animal husbandry, we know the life laws of crops and insects, we know how to plan our agricultural output. In effect, we have enhanced the future of everything—except the overall future of the human race.

The time has come for us to evolve an ecology of man in harmony with the constantly unfolding ecologies of other living things. We need a man-centered science which will seek to determine the interrelationships of life, interrelationships whose understanding will enhance the condition of man.

One could contemplate the United States a century from now with equanimity if our growth rates and growth patterns reflected a mature, purposeful national will. Arrogant events and the headlong pace of material progress have left us little time to ask what people are for, or to agree on long-term societal aspirations. We have learned neither how to grow, nor at what pace, and **that** is our failing and our future trouble.

If we are to establish the secure foundations of an equal-opportunity society and master the sensitive arts of building a life-encouraging environment, then at this moment in history we need to realize that:

Bigger is not better; slower may be faster; less may well mean more.

Stewart L Udall

Secretary of the Interior

Photo by David Muench—Country Beautiful Magazine

Grand Teton National Park, Wyoming

CONTENTS

6 INTRODUCTION

17 LAND RESOURCES
- Bureau of Outdoor Recreation • 18
- National Park Service • 24
- Geological Survey • 29
- Bureau of Land Management • 34

41 FISH AND WILDLIFE RESOURCES
- Bureau of Sport Fisheries and Wildlife • 42
- Bureau of Commercial Fisheries • 48

53 WATER RESOURCES
- Bureau of Reclamation • 54
- Federal Water Pollution Control Administration • 61
- Office of Saline Water • 67
- Office of Water Resources Research • 69
- Bonneville Power • 70
- Southeastern Power • 74
- Southwestern Power • 74
- Alaska Power • 74

75 MINERAL AND FUEL RESOURCES
- Bureau of Mines • 76
- Office of Coal Research • 81
- Office of Minerals and Solid Fuels • 82
- Office of Oil and Gas • 82
- Oil Import Administration • 82

83 HUMAN RESOURCES
- Bureau of Indian Affairs • 84
- Office of Territories • 91
- Job Corps • 92
- Science Adviser • 94
- Office of the Solicitor • 94

98 A REPORT TO OUR STOCKHOLDERS

100 ACKNOWLEDGMENTS

Photo by Vermont Development Department

Introduction

Man is a threatened species. The twin specters facing him are overpopulation and unbridled technology—both self-induced.

The double threat is aimed most directly at man's environment. As the United States strives to accommodate more human beings than it has ever had to serve before, increased demands are placed on our natural resource bank. Our surroundings become increasingly crowded, noisy, and soiled.

The environmental squeeze from technology and population pressures is more than the mere loss of mineral reserves, air and water quality, and forest resources. These are losses that can be measured—in used tons of ore, in coliform bacteria count, in felled board feet—and these measurements suffice to describe what is happening to the parts of our world we must breathe and drink and feed on.

But we have yet to devise a satisfactory index to measure the diminishing quality, the creeping vulgarity and ugliness, of those environmental components which man must look at, listen to, work with, and play in.

Searching back into prehistory, we find that almost every loss of a life form or species has been caused by one or a combination of three things: Intensive specialization leading to an evolutionary deadend, geological or climatic forces which proved catastrophic, or some other species of fatally inimical life.

It is remarkable that throughout millions of years of evolutionary struggle toward humanity, the life form which was to become man escaped the trap of specialization. This changing, adapting species with its human destiny, managed to maintain its options. It also survived the elements.

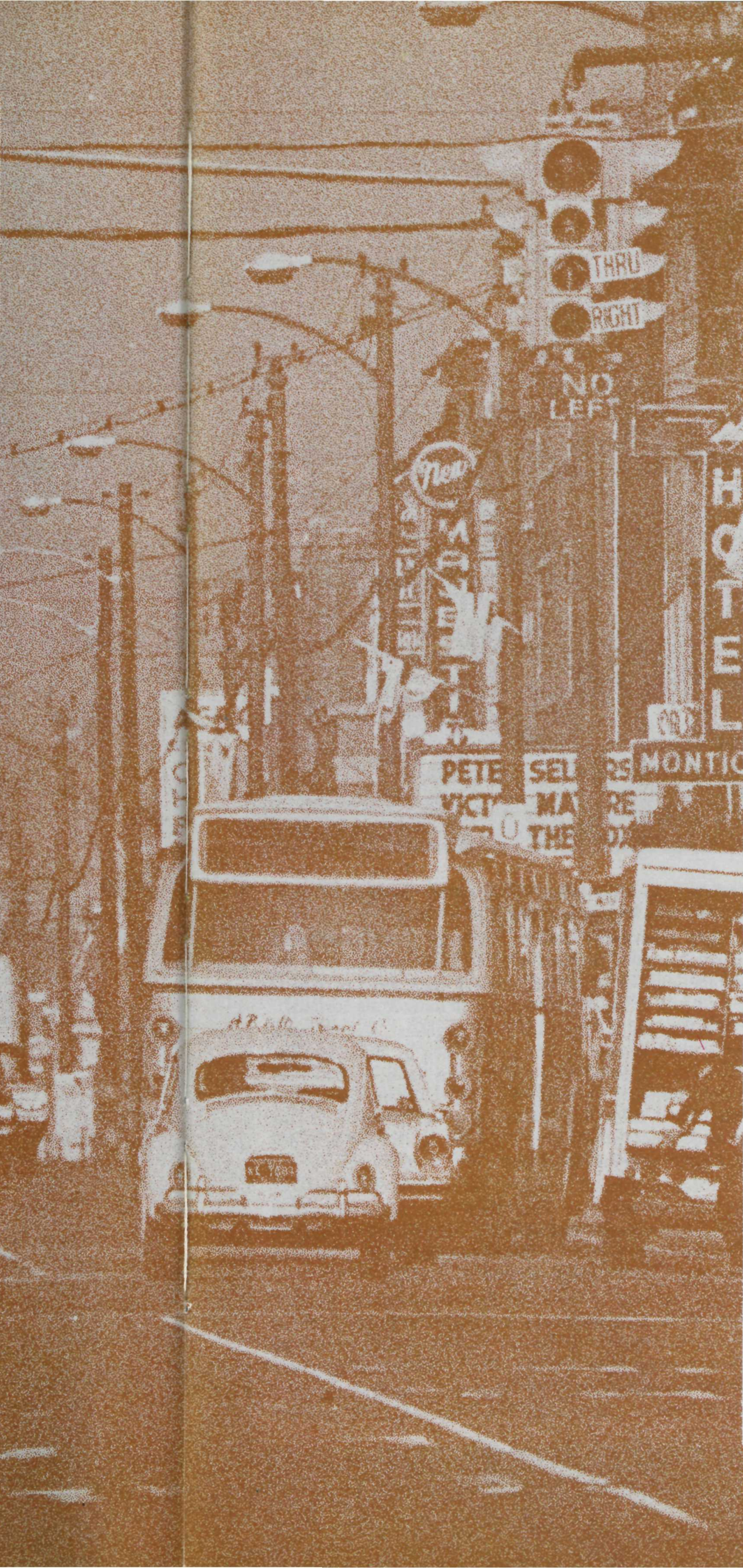
The third threat—from a strain of hostile life—remains a force to be reckoned with. That threat is man himself.

Having avoided the fatal turn of the evolutionary road which led other life forms to an overdeveloped hide, a wing, or a fin, man has used his grasping hand and his creative brain to build himself another kind of trap—a technological trap—and he is crowding it with ever-increasing numbers of his own kind.

The question becomes, most urgently: Is man *still* exercising free choice—that one absolute necessity if he is to avoid the fate of the dinosaurs and the dodos?

Buffeted by the elements and beset by other life forms, man has always stubbornly insisted on exercising every option open to him. Does he still run his own

Photo by Roger L. Williams



show today: Or has he finally stumbled upon two forces —population and technology—that he considers too sacred to tamper with: Is he still convinced that the roaring crescendo from babies and bulldozers is the sweet music of progress?

Does he confuse technology with science? Will he continue to accord to the jackhammer the same revered status as the test tube? Or will he recognize in time that the tools he uses to rip up mountains and destroy estuaries must be extensions of his mind as well as his muscle? Will he see that science must remain free, since it is the *search* for truth, but that technology is only a means of *applying* truth—and that these applications need the control and balance of wisdom and a concern for posterity?

Man stands at a fork in his environmental road to the future.

The two arms of the signpost do not state categorically, "Man—Master of Himself" and "Man—An Extinct Species," but it is increasingly apparent that the direction he takes now will move him rapidly along the path toward one or the other destination.

Let us look closely for a moment at this creature who pauses at the crossroads and clamors for attention with our own voice. Who is he? Where has he come from and how has he made the journey this far?

Anthropologists tell us he is the product of millions of years of evolution—his being literally shaped by the environment without and the life force within. During all these eons he fought a pitched battle for survival. His attitude toward nature was understandably ambivalent, for nature was his best friend and his worst enemy.

In the beginning, his progress was agonizingly slow, his survival often in doubt. But with the passage of the ages and with a cunning constantly sharpened by the struggle for survival, man established himself at the top of the totem pole of life. He went from flint and flame to rocket-powered flight, with ever increasing speed, until he had created a veritable juggernaut against nature and, in so doing, against himself. Now that he has forced the lock on Pandora's nuclear tool box, his capacity to tamper with his environment and his destiny is virtually limitless.

Today, the most significant thing about change is the speed at which it is occurring. The acceleration rate of tooled tampering with our environment is in the

Background Photo by Frank Hoy—The Washington Post

Photo by Vermont Development Department

nature of a nearly vertical line on the chart of time. Its path is almost straight up—its destination out of sight.

We are in desperate need of guidelines, but too often our steering apparatus is geared to a tomorrow projected off on a horizontal time-line from today. In reality, when tomorrow becomes today, it will probably be breaking somewhere far over our heads instead of off to one side.

We cannot alter the past. At current speeds, the present becomes the past even as we set hand to it. At such speeds, our options for today are drastically narrowed. Only tomorrow can be dealt with.

The technology to shape tomorrow is in our hands. What is still needed, and urgently, are the social and political means of giving intelligent direction to the awesome tools we have fashioned.

The speed of change has introduced a new danger—the increasing role that chance plays in our human society and its interactions with the natural environment. Man's adaptability, which allowed him to make the dangerous passage from the world of the merely organic into the world of thought, "shorn of fangs and fur and claws," as the poetic anthropologist Loren Eiseley puts it, is today being sorely taxed as it tries to cover the expanding range of choice.

Says Professor Eiseley: "Choice, even intelligent choice, becomes increasingly hard to make among an infinite number of diverging pathways some of which show signs of leading into new and dangerous corners."

The late Robert Oppenheimer, physicist, wrote: "One thing that is new is the prevalence of newness, the changing scale and scope of change itself, so that the world alters as we walk in it, so that the years of a man's life measure not some small growth or rearrangement or moderation of what he learned in childhood, but a great upheaval."

Professor Eiseley put the same idea this way: "I myself, like many of you, have been born in an age which has already perished . . . I will not be merely old; I will be a genuine fossil embedded in onrushing man-made time before my actual death."

The warning is clear. While we indulge in worthy, earnest, but nevertheless limited enterprises such as saving the whooping cranes, we fail to notice our own growing eligibility for the title "endangered species."

The terrible urgency of accelerated change as a focus for intensive application of human brains is summed up in the phrase "technological momentum." Admiral Hyman Rickover told a 1966 meeting of the Royal National Foundation in Athens, Greece: "If people understood that technology is the creation of man, therefore subject to human control, they would demand that it be used to produce maximum benefit and do minimum harm to individuals and to the values that make for civilized living."

"Unfortunately," Rickover continued, "there is a tendency in contemporary thinking to ascribe to technology a momentum of its own, placing it beyond human direction or restraint—a tendency more pronounced in some countries but observable wherever there is rapid technological progress."

We have, no matter how dimly we perceive it, a moral obligation to the future. Kenneth Boulding, the economist, has observed that it is always hard to find a convincing answer to the man who says, "What has posterity ever done for me?"

"The whole problem," Boulding maintains, "is linked up with the much larger one of the determinants of the morale, legitimacy, and 'nerve' of a society, and there is much historical evidence to suggest that a society which loses its identity with posterity and which loses its positive image of the future loses also its capacity to deal with present problems, and soon falls apart."

In a world which is essentially (with the important exception of solar energy) a "closed system," our primary considerations are those of extraction and waste disposal. As we extract our natural resources we diminish them. As we dispose of waste products, we contribute to pollution. Ironically, it is the waste rather than the supply problem that demands our prior attention.

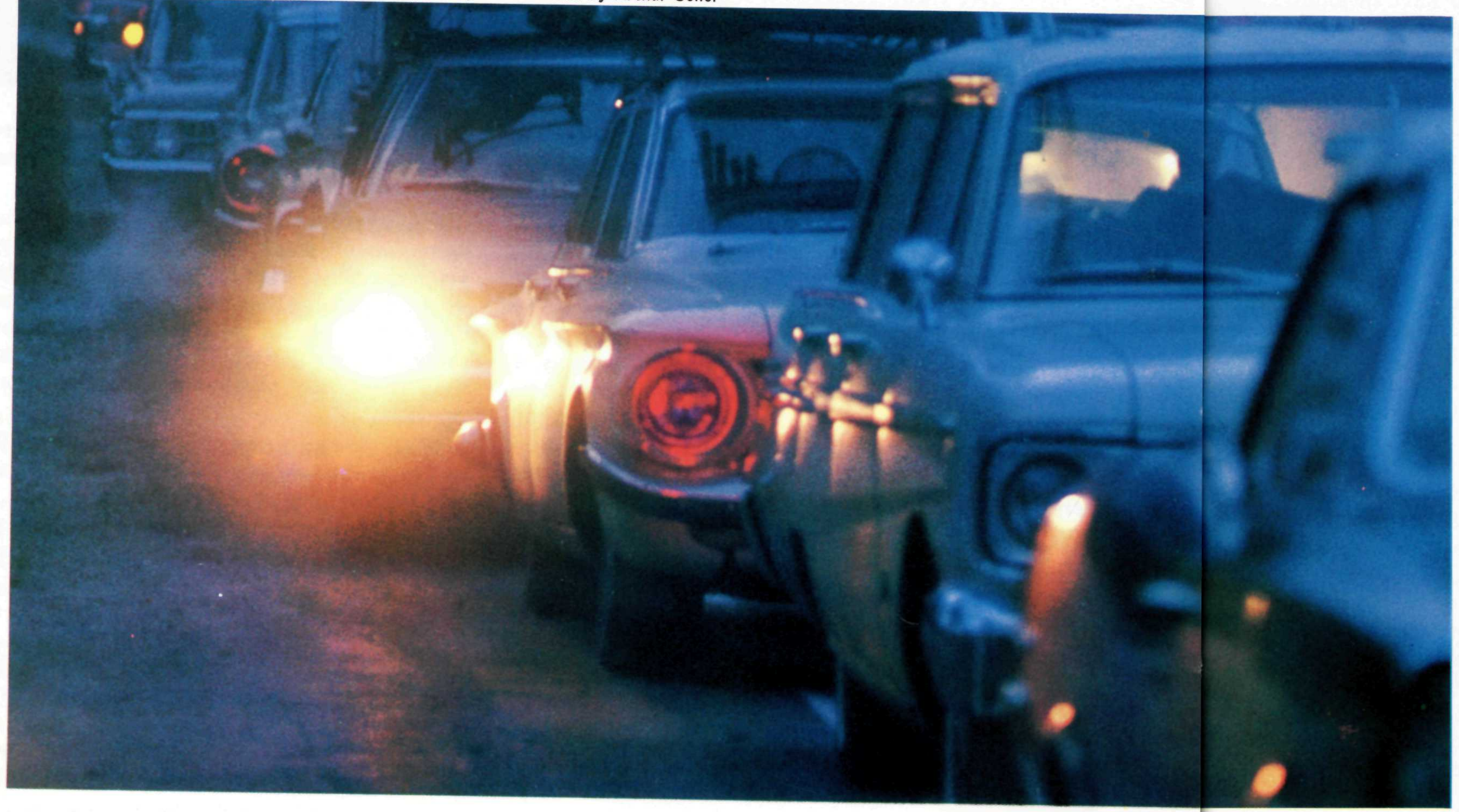
With air and water in many places exhibiting signs of intolerable overload, this question of waste disposal has become one of the prime threats to human survival. The attempts being made today to remove man from the endangered list are aimed in large measure at this threat.

Economist Boulding is hopeful that "as a succession of mounting crises, especially in pollution, arouse public opinion and mobilize support for the solution of the immediate problems, a learning process will be set in motion which will eventually lead to an appreciation of and perhaps solutions for the larger ones."

The earth has been likened to a spaceship on which

Background Photo by Frank Hoy—The Washington Post

Standard Oil Company (New Jersey)—"The Lamp" Magazine—Photo by Arthur Seller



man must carry all his needs and live with all his waste products. It is within this closed-system context of our predicament that we must consider our pollution problems. Again, we find science a mixed blessing. For while we can be fairly sure of discoveries that will lead to new ways of supplying needed materials and energy, these new supplies lead to new waste problems, such as the insidious and inadequately charted contamination from man-released radioactive materials.

As we crowd more and more people into the spacecraft (and population growth becomes "exponential" when it is significantly freed from such checks as disease) then we face an eventually impossible situation, but one that carries some tragic possibilities on the way to the ultimate impossibility. An example:

Rene Debos, in an essay on "Environmental Quality in a Growing Economy," says that "the problems posed by adaptation to crowding bid fair to change in character and to become of increasing importance in the near future . . . Furthermore, experimental studies with various animal species have revealed that excessive crowding results in many forms of behavioral disturbances, ranging from sexual aberrations to cannibalism or . . . more interestingly to complete social unresponsiveness."

Thus the question of whether we are to survive on this planet at all becomes not just one of controlling the birthrate but of whether, along the way to the critical mass of humanity, we create conditions that will make existence well-nigh intolerable.

It has been noted, and fairly, that the only question with relation to the future of world population is whether the inevitable decline in rate of growth will come about through a tremendous upsurge in the death rate or through a drastic fall in the birth rate. Over the long haul, these two solutions represent our only choice. The former will mean unprecedented human misery; the latter, unprecedented human wisdom.

The problems created by thoughtless growth in some areas of technology are sometimes compounded by lags in other areas. There has been, for instance, a regrettable lack of technological activity in solving air pollution, where our problems are chronically aggravated by an automobile whose internal combustion system has hardly progressed since it was adopted. A true pursuit of technological improvement might well have solved the exhaust pollution problem long before it became the near tragedy it is today.

It is generally conceded that we have now, or know how to acquire, the technical capability to do nearly anything we want to do. Possessing such capability (and here it is well to draw a parallel distinction to that between science and technology—the distinction between capability and wisdom), we have a duty to shift the emphasis far more heavily from "how can we do it?" to "*should* we do it?"

This is the central question facing modern conservation. With so many humans inhabiting the environs, and with such powerful tools for shaping the environment, where should we move ahead, where should we hold back, and what directions should we take?

We must start by rejecting what we *cannot* do. Walter Sullivan, science columnist for *The New York Times,* wrote on March 25, 1967: "In a world of proliferation—proliferation of human beings, of nuclear weapons, of food additives—unplanned, uncontrolled technological growth can no longer be tolerated. . . . The world has become too dangerous for anything less than utopias."

We are not likely to find many utopias lying around, tied up in neat packages of total solutions. Our main hope is that we are beginning to understand the totality of the problem of survival. The threats to this survival are woven in a skull and crossbones pattern into the fabric of our entire world; it crisscrosses the boundaries between the social and the natural. We cannot continue to exist if we do not take care of our natural world, and we cannot exercise the life-or-death brand of stewardship required without massive exercise of wisdom at the social level.

The time span remaining for constructive action is short. The future slips into the past at a blurred clip and our hope lies with those whose vision is as wide as the problem and whose courage is a match for the corrective measures so urgently needed.

What is called for is some sort of concert to the action in every segment of our society. Whether those involved are sociologists, economists, foresters, agronomists, biologists, public office holders or private corporate decision-makers, their minimum mutual goal is the meaningful survival of man and his planet. A more ambitious objective would be to fashion for tomorrow a world we think we ourselves might be happy to inhabit. There are hopeful signs that we may not just survive, but that we may may even enjoy it.

Why is a Department which is primarily responsible for the natural resources of this nation so concerned about the random growth of technology and population?

The answer is simply that in technology and population lie the roots of most of our resource problems.

In the past, as the idea of conservation grew, we tended to separate our environment into its many components—forests, wildlife, minerals, soil, water—and to deal with each separately. This piecemeal approach has proved inadequate. As we dealt with the various parts of the periphera, the core of the problem—which is mindless tampering with the environment—was creating new problems all over the surface.

So profound and all-pervasive are the effects of exploding population and expanding technology that efforts to deal with environmental problems are unlikely to be effective in a long-term sense unless we turn our attention to these two root factors.

Conceivably, this could be the Planet of Eden without man. Nature could go back to keeping her own tempo. Lakes would appear and die, their aging processes unhurried by human wastes, keeping time to the leisurely beat of the life symphony as it was before men and machines changed the score. Mountains would wear down gradually from wind and water, without the swarming action of bulldozer, power shovel, and the blast of explosives. The air would revert to the tenancy of birds, whose population balances would shift into harmony with a world shorn of such civilized graces as pesticides and pavement.

Our remaining minerals and fossil fuels would lie untouched in their cradles in the earth's crust. The underground fires in abandoned coal mines would wink out, one by one, and the scabrous mountainsides would pull a healing bandage of brush and trees over their strip-mine scars and settle down to the gentler touch of the ages.

But this kind of ending to environmental mayhem would be meaningless—to us at least—if man were dealt out of the picture.

There *are* other ways to sanity in the natural world. Conservation requires man in order to have meaning; it does not require an end to the technology which serves man—in many cases extremely well. What it does mean is that man must exercise control—over himself, first, and then over his tools.

Man requires wood, but he has learned that he can take the tree and spare the forest. He must extend this insight to include consideration for recreation, scenic, and historic values as he supplies his need for wood fiber.

Man requires fresh water. He has learned that he can treat his wastes before returning them to the waterways and thus extend the usable life expectancy of his stream systems. He has still to learn how thermal pollution affects the plant and animal life of his waters, how to protect his vital estuaries so as not to break the chain of marine life in favor of ill-considered human developments, how to draw water from the clouds that now react only to the whims of weather.

Logging, fishing, farming, grazing, swimming, boating, housing, manufacturing—all these activities directly involve our natural resources and our lives. As men proliferate, they find these necessary human activities coming more and more into competition with one another. The logger and the nature lover rub against each other's grain. The estuarine developer serves the home owner but destroys the fisherman's living. The manufacturer may raise our indoor living standard while he kills an entire river with his deadly chemical wastes.

As man and his machines come to grips, the environ-

Standard Oil Company (New Jersey)—"The Lamp" Magazine— Photo by J. R. Eyerman

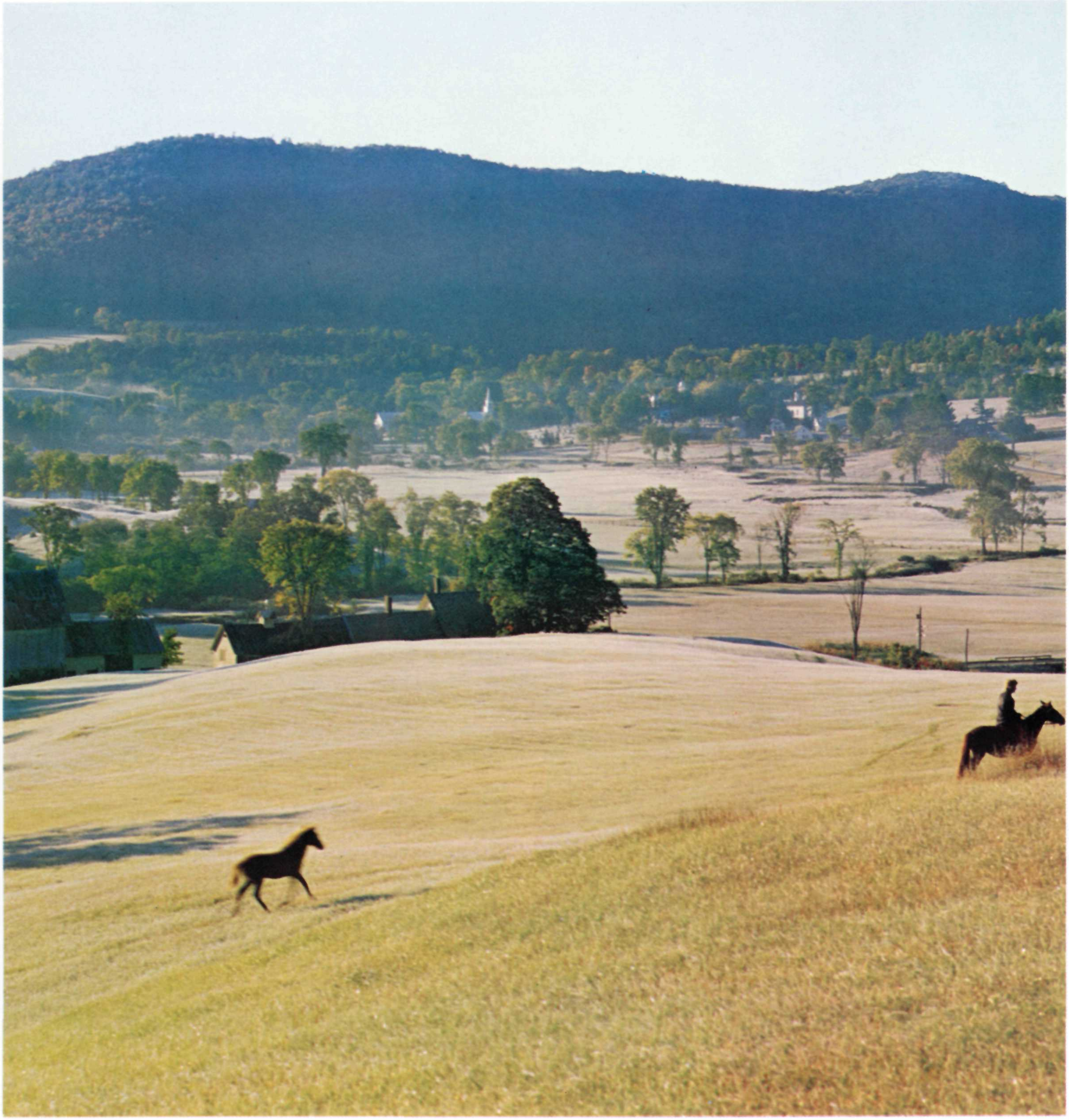
ment is caught in the squeeze. The resulting distress signals have not gone unheeded. The unmatched conservation record written by recent Congresses is an apology to the past and a pledge to the future. It faces up to our vanishing open spaces, our murky air and dying waters, our shrinking resources and endangered wildlife. It is a bread and butter letter to our environment. And it demonstrates that a non-partisan conservation conscience is part of the body politic—shared by men and women of every political coloration.

The conservation task, with all its contradictions and urgency, demands a world view and the highest wisdom, courage and energy we can accord it. More and more of our most highly educated, deeply motivated men and women are electing to spend their talents in building a better environment. Their work seldom makes headlines; it is content to make a world.

As the Federal agency with the widest variety of conservation tasks, the Department of the Interior operates all over the environmental spectrum. It carries out routine, day-to-day "housekeeping" chores. It makes difficult policy decisions, often involving irreversible changes in our overall resource picture. And sometimes it must act as the voice of an otherwise lobbyless nation in serving an overriding but silent public interest.

The following pages provide highlights of the work being done by the various bureaus and offices of the Department of the Interior in the interests of man—the species, and his environment—the world.

LAND RESOURCES 1



Meadow Scene—South Strafford, Vermont.

MAN . . . an endangered species?

"Support is required not just for a battle here, or a rear-guard action there, but for a fundamental and continuing program to make our country a better place in which to live, a cherished place of beauty passed on with pride from one generation to the next."

Senator Henry M. Jackson
Washington

"We conserve so that our own and future generations will be able to enjoy. If they are not permitted to enjoy, there is little justification for conservation."

Congressman Wayne N. Aspinall
Colorado

Bureau of Outdoor Recreation

Recreation, in its truest sense, is a creative use of leisure. Time wisely used outdoors is a renewing experience for individuals. Rested, re-created individuals make a stronger, more vibrant Nation.

We hear more today than ever before in our history about open space, quality of environment, recreation, and natural beauty. These terms tend to overlap and fuse in the common effort to improve the quality of our lives.

President Johnson has put the situation in perspective:

"The purpose of protecting the life of our Nation and preserving the liberty of our citizens is to pursue the happiness of our people. Our success in that pursuit is the test of our success as a Nation. For a century we labored to settle and subdue a continent. For half a century we called upon unbounded invention and untiring industry to create an order of plenty for all of our people. The challenge of the next half century is whether we have the wisdom to use that wealth to enrich and elevate our national life, and to advance the quality of American civilization."

Across America the voters have shown a distinct partiality for improving their surroundings and the quality of their lives. In numerous State, city, and county elections, majorities have balloted in favor of restoring natural beauty, acquiring lands for parks, and developing means to deal with pollution.

In keeping with this trend, the Bureau of Outdoor Recreation (BOR) was established in 1962 to provide a focal point within the Federal Government for outdoor recreation planning, coordinating, and policy matters.

The Bureau's programs are designed to help the Nation meet present and future outdoor recreation needs and to improve the quality of our environment.

Outdoor Boom Accelerates

Americans are continuing to turn to the outdoors for recreation, relaxation, and rewarding use of their leisure time as never before, a move that began to accelerate just after World War II. Pressures on public and private outdoor recreation facilities are exceeding previous expectations by wide margins.

By the year 2000, participation in major summertime outdoor recreation activities will be four times greater than it was in 1960. Only a three-fold increase had been anticipated.

Outdoor Recreation Trends, a BOR report, shows that public participation in major outdoor recreation activities increased a sturdy 51 percent between 1960 and 1965.

"The surge to the outdoors is highly gratifying but it creates multiple problems," Secretary Udall said. "We will need to combine new and novel methods with

Open spaces for expansion and re-creation of the human spirit are vital to the health of our towns.

our traditional approaches to meet the demand for needed public land and private recreation opportunities."

The survey found that walking for pleasure has become America's most popular form of outdoor recreation in the summer. More than 67 million persons took pleasure walks in 1965, averaging 15 per person—an 82 percent increase over a five-year period.

Swimming is second in popularity as a summertime public recreation activity. It will move up to first by the year 2000 if present trends continue. Driving for pleasure ranked third in 1965, contrasted with first in 1960. Following, in order, were other preferred activities for 1965: Playing outdoor games or sports, bicycling, sightseeing, picnicking, fishing, attending outdoor sports events, boating, nature walks, camping, horseback riding, water skiing, hiking, and attending outdoor plays and concerts.

The survey was based on information gathered by the Bureau of Census for June, July, and August 1965. The survey does not detail peak season participation in hunting, snow skiing, spectator sports, and other fall and winter sports. It did reveal, however, that some 17 million Americans hunt and nearly 6 million snow ski each year.

Nationwide Outdoor Recreation Plan

Statistics in the *Trends* report will be used by BOR in preparing a long-range Nationwide Outdoor Recreation Plan which will be submitted to the President and Congress in 1968. After that year, the Bureau will update the plan periodically.

The plan will: . . . be designed to help guide development of sound public policy in outdoor recreation and to assure that Americans are able to enjoy the kinds of recreation they desire; . . . consider outdoor recreation in the broadest sense (It will encompass urban and rural, public and private programs); . . . project the Nation's outdoor recreation demands to the years 1980 and 2000, and recommend measures to assure that such needs are met; . . . guide the outdoor recreation programs of other Federal agencies.

Land Price Escalation

A report by the Bureau of Outdoor Recreation on price escalation in recreation lands emphasized the need for new legislative and administrative actions.

The report stemmed from a six-month study by the Bureau, aided by other Government agencies. It responded to a directive from President Johnson and expressions of concern by the Senate and House Committees on Appropriations and Interior and Insular Affairs.

One of the best ways to avoid the pitfalls of speculation, the report concluded, is to buy recreation lands promptly after acquisition is authorized rather than postpone purchase for months or years.

"The need to keep land costs within reach is urgent," Secretary Udall declared. "Unless effective action is taken to combat the land price escalation spiral, many needed park and recreation areas may never be acquired."

The study disclosed that land values throughout the Nation are rising 5 to 10 percent annually and the cost of lands suitable for public recreation use is rising even faster. Indications of Federal interest apparently trigger significant price escalation.

States and their political subdivisions are faced with land price escalation problems similar to those of the Federal Government.

Costs of land needed for federal and state outdoor recreation purposes during the next 10 years are estimated at $3.6 billion. The Land and Water Conservation Fund, under its present revenue system, would fail by around $2.7 billion to meet minimum federal and state recreation program needs. Revenues to the Fund now run around $100 million a year.

The report recommended putting money received from Outer Continental Shelf and other mineral leases into the Fund and the use of advance appropriations authority to supply enough money to complete acquisition of authorized federal areas within three years.

Inventory of Islands

In another action designed to provide needed recreation lands, President Johnson directed Secretary Udall to conduct the first nationwide inventory of American islands 10 acres or larger. The study is to be completed by late 1968.

Islands off the Atlantic, Pacific, and Gulf Coasts and in inland waters are among the Nation's last great reserves of high-quality unspoiled land available for recreation use.

In ordering the island study, President Johnson noted that the 89th Congress had voted to preserve some 140 miles of seashore and lakefront in near-natural condition at the Assateague Island and Cape Lookout National Seashores off the Maryland-Virginia and North Carolina coasts, and Pictured Rocks and Indiana Dunes National Lakeshores in Michigan and Indiana. Since 1961, other Congresses have authorized National Seashores at Cape Cod, Massachusetts; Padre Island, Texas; Point Reyes, California; and Fire Island, New York.

Wild and Scenic Rivers

At year's end, Congress was considering setting aside forever portions of several of the Nation's wild and scenic rivers.

In his January 30, 1967, *Message to Congress on Protecting Our Natural Heritage,* President Johnson renewed his earlier recommendation for establishment of a scenic rivers system.

A joint Interior-Agriculture study to determine the need for a national system of scenic or wild rivers was completed in 1965. That study considered more than 700 rivers, made preliminary investigation of more than 60, and detailed examination of around 15.

The Department of the Interior proposed immediate establishment of all or parts of the following rivers for immediate designation as national scenic rivers:

The Salmon and Middle Fork of the Clearwater in Idaho, Rogue in Oregon, Rio Grande in New Mexico, Eleven Point in Arkansas and Missouri, Cacapon and Shenandoah in West Virginia, St. Croix in Minnesota and Wisconsin, and Wolf in Wisconsin.

The proposal also suggested that additional qualified river segments be considered for designation as national scenic rivers in future legislation. It named 35 rivers for early consideration. Such rivers would be essentially free-flowing and unpolluted rivers, or sections of rivers and related land areas with outstanding scenic, fish, wildlife, and outdoor recreation values.

At the direction of Congress, BOR also is studying the Connecticut, Missouri, and Hudson Rivers.

After visiting the Connecticut River, Secretary Udall said: "Like most of our rivers, the Connecticut is in trouble. Scenically, its lower stretch from Hartford to the sea is surprisingly unspoiled. But its special appeal stops at the river's edge. Thus the country over, the very streams that should provide fresh water and outdoor recreation for all, flow sullenly by our cities and emit odors that cause a river-loving people to turn away from them with distaste."

In cooperation with other Federal agencies and States involved, BOR is studying the feasibility of establishing all or parts of the Connecticut River Valley in Connecticut, Massachusetts, Vermont, and New Hampshire as a National Recreation Area. The Bureau's report and recommendations will be submitted to the President in 1968.

National concern over the condition of the Hudson River led to a study of that waterway under the leadership of BOR. A report, *Focus on the Hudson*, recommended establishment of a Federal-Interstate compact and other measures to preserve and enhance the scenic, recreation, historic, and other natural resources of the Hudson River Valley.

A Federal law passed in 1966 directs the Secretary of the Interior to negotiate such a compact with the States of New York and New Jersey. It also directs the Secretary to review all Federal plans and programs affecting the Hudson to avoid adverse actions pending agreement on a compact. The Secretary is to report to the President and the Congress by July 1, 1968, on the progress of negotiations.

The Bureau of Outdoor Recreation is responsible for the staff functions on the Hudson project.

At the request of the Senate Interior and Insular Affairs Committee, BOR is studying the recreation resources of 1,265 miles of the Missouri River from Yankton, South Dakota, to Fort Benton, Montana, regarding possible establishment of a National Recreation Area.

Nationwide System of Trails

Another proposal to improve the quality of the American environment is a nationwide system of trails. President Johnson directed Secretary Udall to consult other federal agencies and state and local groups to develop recommendations for such a system.

Secretary Udall appointed an interagency group, headed by BOR, to study national, regional, state, and local trail needs.

From this emerged a report, *Trails for America*, the first major effort to gather facts on national trails potential and to recommend a program to enhance trail opportunities.

Three types of trails were proposed: *National Scenic Trails*, such as the Appalachian Trail, to provide extended hiking experiences in primitive or historic settings; *Park and Forest Trails* in federal and state areas for campers and other vacationers; and *Metropolitan Area Trails* to offer near-home opportunities for walking, bicycling, or horseback riding.

A Department of the Interior proposal to Congress recommended immediate designation of the Appalachian Trail, the Potomac Heritage Trail, the Pacific Crest Trail, and the Continental Divide Trail as National Scenic Trails.

The Appalachian Trail extends along the Appalachian Mountains for some 2,000 miles from Maine to Georgia. The Continental Divide Trail extends 3,100 miles along the Continental Divide between southwestern New Mexico and the Canadian border in Glacier National Park. The 2,313-mile-long Pacific Crest Trail runs from the Mexican border in California along the mountain ranges of the West Coast States to the Canadian-Washington border. The Potomac Heritage Trail extends 825 miles from the mouth of the Potomac River to the river's sources in Pennsylvania and West Virginia. It includes the 170-mile Chesapeake and Ohio Canal Towpath.

The Department's proposal also calls for improvement and expansion of existing trails, development of more trails within national parks, forests, and other federal lands, and for study of eight other trails for possible future adition to a National Scenic Trail System. It likewise seeks to encourage state and local governments to consider trail needs.

The President's Council and Advisory Committee

The President's Council on Recreation and Natural Beauty and Citizens' Advisory Committee on Recreation and Natural Beauty, which President Johnson established in May 1966, have directed their attention to the broad problems of restoring and preserving the quality of the environment.

The Council is preparing a report to the nation on natural beauty to define the breadth of environmental concerns, detail major progress, and suggest ways to protect the nation's physical surroundings.

The Council also has studied opportunities for using federal property to protect environmental quality and to increase outdoor recreation services; regional recreation planning to help meet increasing visitor pressures at key recreation attractions; federal policies toward concessioners on public lands; and scenic roads and parkways.

In its first annual report to the Council, the Citizens' Advisory Committee on Recreation and Natural Beauty stressed the importance of highways to the environment. It urged the Secretary of Transportation to establish a Highway Review Board to advise him concerning controversial highway projects which raise issues of national policies. It also recommended that the governor of each state establish similar procedures.

Also recommended were examination of scenic road program proposals; revision of standards for highway signs; interagency recreation planning; and reexamination of the recreation fee system on federal lands.

The Committee named an Electric Utility Industry Task Force—with all segments of the industry represented—to seek ways to eliminate conflicts between natural beauty and industry facilities. The Task Force is concentrating on ways to bury distribution lines, improve the appearance of structures, and location of atomic power plants to detract as little as possible from natural beauty.

Subcommittees are making highway studies and considering ways to improve educational methods in the field of conservation.

States and the Conservation Fund

During 1967 the grants-in-aid program to states for outdoor recreation planning, acquisition, and development authorized by the Land and Water Conservation Fund Act of 1965 accelerated rapidly.

At the close of fiscal 1967, BOR had processed more than 2,000 requests from states for Land and Water Conservation Fund grants. In a 30-month period—January 1, 1965 to June 30, 1967—the Bureau approved some 1,700 matching grants totaling approximately $96 million to states, cities, and counties.

The Fund is supported by revenues from recreation fees collected at federal recreation areas, sale of surplus real property, and U.S. motorboat fuels tax.

Total revenues accrued since the Fund began in 1965 totaled $233 million. About 60 pecent of the revenues ultimately are allocated to the states, 40 percent to federal agencies.

To receive Fund assistance for outdoor recreation acquisition and development projects, states must keep up to date acceptable statewide outdoor recreation plans. All 50 states, the District of Columbia, Guam, Puerto Rico, American Samoa, and the Virgin Islands have submitted acceptable plans.

The Fund program has stimulated states and local outdoor recreation expenditures, thus adding substantially to outdoor recreation opportunities.

BOR also allocates money from the Fund for purchase of authorized federal recreation lands and waters by the National Park Service, Forest Service, and Bureau of Sport Fisheries and Wildlife.

The Administration stresses the need to locate recreation areas and facilities near urban centers.

Land and water areas added by the Park Service, the Forest Service, and the Bureau of Sport Fisheries and Wildlife in fiscal 1967 were priority acquisitions for meeting recreation needs or preserving endangered species. Acquisitions are scheduled as far as possible in areas with the greatest deficit in recreation resources. For example, most of the Forest Service acquisitions and many by the National Park Service are in the eastern part of the country.

The three agencies just mentioned received a total of approximately $80 million from the Fund in fiscal 1965, 1966, and 1967. Most of this money is being spent for new national recreation areas, seashores, lakeshores, and parks. The rest is being used to expand existing national parks and national forests and to help protect certain species of wildlife.

Recently authorized areas being financed out of the Fund include Delaware Water Gap National Recreation Area in Pennsylvania and New Jersey; Indiana Dunes National Lakeshore in Indiana; Whiskeytown-Shasta-Trinity National Recreation Area in California; Assateague Island National Seashore in Maryland and Virginia; Cape Cod National Seashore in Massachusetts; Fire Island National Seashore in New York; Pictured Rocks National Lakeshore in Michigan; Guadalupe National Park in Texas; Cape Lookout National Seashore in North Carolina; Spruce Knob-Seneca Rocks National Recreation Area in West Virginia; and Mt. Rogers National Recreation Area in Virginia.

New National Parks Supported

BOR participated extensively in preparing and supporting the Administration's proposals to establish two new National Parks—Redwood in California and the North Cascades in Washington State.

The Administration asked that the Redwood National Park consist of a 41,834-acre unit in Del Norte County and 1,600-acre Tall Trees Unit in Humboldt County.

A legislative proposal, worked out by the Departments of the Interior and Agriculture, includes a North Cascades National Park, consisting of approximately 570,000 acres; a Ross Lake National Recreation Area of about 100,000 acres; and the Pasayten Wilderness of about 500,000 acres. It also provides for addition of about 10,000 acres to the present Glacier Peak Wilderness.

Natural Beauty and Highways

An important new national policy to preserve federal, state, and local parklands, historic sites, and their natural beauty in highway planning was established with the approval of the 1966 Federal-Aid Highway Act and the Department of Transportation Act.

The Transportation Department Act declares it to be a "national policy that special effort should be made to preserve the natural beauty of the countryside and public park and recreation lands, wildlife and waterfowl refuges, and historic sites."

Photo by Woodbridge Williams

The serene beauty of Maine's Allagash River (above) reflects Governmental effort to preserve places of truly spectacular scenic value. The private sector adds its piece to the outdoor recreation picture by turning a worked-out sand and gravel pit (below) into an attractive swimming area.

Photo by National Sand and Gravel Association

The Act also directs that the Secretary of Transportation shall cooperate and consult with the Secretaries of Interior, Housing and Urban Development, and Agriculture and with states in developing transportation plans and programs that include measures to maintain or enhance the natural beauty of the lands crossed. The Secretary of the Interior delegated responsibilities under the Transportation Act to BOR.

Technical Assistance

During the past year, the Bureau of Outdoor Recreation, fulfilling its role of providing technical assistance to recreation professionals, has launched *Outdoor Recreation Action,* a quarterly publication designed to provide information on outdoor recreation and natural beauty. The Bureau also produced a number of other technical assistance bulletins and publications, including *Outdoor Recreation for the Handicapped, Space Standards for Outdoor Recreation Areas and Facilities,* and 10 *Community Action Guides for Outdoor Recreation,* the latter in cooperation with the National Association of Counties Research Foundation.

National Park Service

If man is to avoid the plight of an endangered species, the inspirational qualities of the national parks will help him do so. The parks offer relief from the complexities of urban life, despoilment of the countryside, and pollution of our air and waters. These extremes, and the myopia that permits them, are among the forces that could endanger man as a species over the long stretch of history.

Millions of families escape these pressures every year at Grand Canyon, Crater Lake, Cape Cod, and similar spacious areas of the National Park System where they find renewed physical and spiritual strength.

In 1966, Americans and foreign guests made 133,081,100 visits to national park areas. This record attendance, up 9.7 percent over 1965, continues the steady annual increase shown during the 1960's. It is further proof that the National Park System is essential to an environment in which man may attain his full growth, health, and happiness.

When the National Park Service (NPS) observed its golden anniversary August 25, 1966, Secretary of the Interior Udall cited this role of the Park System in these words:

"National parks play a part in helping to enrich the human spirit, the minds and bodies of our citizens. Consequently, we are dealing with a very fragile area which is concerned as much with the conservation of human resources as with natural resources."

President Johnson emphasized the environmental role of the national parks when he told Congress in January of this year:

"We must not only resist the spread of pollution in our environment but we must also preserve what remains of the natural beauty and tranquility that was here long before man came. We must create new occasions for people to encounter that beauty and to experience the re-creation of the heart that occurs in the natural universe."

He then asked Congress to approve a Redwood National Park, a North Cascades area national park, a Potomac Valley Park, and an Apostle Islands National Lakeshore on Lake Superior.

The President stressed the international scale of man's efforts to assure a favorable environment when he met President Diaz Ordaz of Mexico at Amistad Recreation Area on the Rio Grande, December 3, 1966. NPS administers the American portion of this area.

At Amistad—the Spanish word for friendship—where the United States and Mexico are creating an 80-mile lake near Del Rio, Texas, the Presidents hailed this "development of a great water recreational faciity for the two countries."

Growth and Regrowth

The effectiveness of NPS in managing its 259 areas and 27.5 million acres takes many forms:

In Yellowstone National Park (Wyoming-Idaho-Montana), NPS signed a 30-year contract with a concessioner to help the park meet the visitor wave of the future. The Yellowstone Park Company agreed to complete a $10 million construction program by June 30, 1975.

The Service completed contracts with concessioners for construction programs of $1,375,000 at Lake Mead National Recreation Area (Arizona-Nevada); $865,000 at Sanford Recreation Area (Texas); $500,000 at Grand Teton National Park (Wyoming); $350,000 for a road-saving tramway in Glen Canyon National Recreation Area (Utah-Arizona).

In Rocky Mountain National Park (Colorado), campers watched curiously as scientists inspected trees, plants, and soils. The researchers were checking to determine the types of vegetation best able to survive the trampling and traffic of a public campground.

At Capt Hatteras National Seashore (North Carolina), a helicopter hovered over a beach. The pilot was spreading fertilizer to speed the growth of grasses designed to stabilize the wind-battered sand dunes.

Alligators in a parched Everglades National Park (Florida) crowded into the last potholes of the Shark River headwaters. They were trying to survive a drought that had become an ecological disaster. Park rangers formed special patrols to protect the 'gators from poachers.

At Chickamauga and Chattanooga National Military Park (Tennessee), 25 Neighborhood Youth Corpsmen transformed 10 unsightly acres into more attractive park grounds. The teenagers improved 25 miles of trail before returning to school healthier and prouder students.

Where Thomas A. Edison invented the motion picture camera at Edison National Historic Site (New Jersey),

Atlantic Richfield Co.—"Automobile Adventures" Magazine—Photo by Woodbridge Williams

Snake birds (ahingas) guard their nest near a trail in Florida's threatened Everglades National Park.

historians added two sets of Edison's original nitrate base films to the museum exhibit. NPS paid the Library of Congress $2,564, a modest price for such rarities. The cost was met by private donation.

By such diverse methods does the National Park System renew our natural, historical, recreational, and human resources. The parks add a fourth dimension to man's basic environment of land, water, and atmosphere, combining the best elements of all three in accord with President Johnson's call for "a new conservation. . . . Its concern is not with nature alone but with the total relation between man and the world around him. Its object is not just man's welfare but the dignity of man's spirit."

Parkscape and Cityscape

In supporting the new conservation, NPS has launched a long-range program of ideas, ideals, and objectives. To reflect the Service's areas of concern—landscape, seascape, cityscape, and shorescape—the program is called PARKSCAPE U.S.A. It seeks to make the beauty and history of the land richer and more meaningful in the daily life of every American; to restore beauty where it has been destroyed; to preserve the surviving natural and historical landmarks of our national heritage.

PARKSCAPE pledges growth of the National Park System in response to human need; cooperation nationally and internationally with all concerned with the quality of our environment; and innovation and education in achieving the goals of the new conservation.

Thus, in asking Congress for a Potomac Valley Park extending through parts of Maryland, Virginia, and West Virginia, President Johnson urged that the Potomac be made a "model of scenic and recreational values for the entire country." In response, a Federal Interdepartmental Task Force on the Potomac, working closely with an Advisory Committee representing the Potomac Basin States, made a comprehensive study of the entire Potomac River Valley. From this emerged a proposal which would protect the main stem of the Potomac and the paralleling Chesapeake and Ohio Canal "in a scenic sheath of green space for the enjoyment of present and future generations."

In the Capital itself, the effects of Mrs. Lyndon B. Johnson's beautification program were refreshingly visible in cheery flowerbeds and neatly clipped hedges of the National Park Service. In response to the First Lady's leadership, the Service has received donations of cash and plant materials valued at $640,000 for improving Washington's parklands. The city's circles and parklets, many of them formerly drab and colorless, blossomed with tulips, azaleas, and other flowers. By June, the spring wave of visitors as well as the 2.5 million inhabitants and commuters of metropolitan Washington had savored the Capital area in one of its most beautiful years.

The Service's urban responsibilities in Washington, New York, Boston, Philadelphia, Baltimore, Richmond, St. Louis, St. Augustine, and other cities have increased its emphasis on health and safety. But man-made fog, smog, sewage, monoxide, refuse, litter, food, and traffic problems are not confined to the cities. The Service has broadened its pollution appraisals, tightened its pollution controls, and strengthened its food and health procedures throughout the National Park System.

It maintains inspections by the U. S. Public Health Service on regular schedules. NPS works closely with state and local governments to move and accommodate visitors in a clean, safe environment.

Wilderness and Landmarks

Wilderness, where man may replenish the resources of his mind and body, is a treasured heirloom handed down by the National Park System from one generation of Americans to another. In accordance with the Wilderness Act, designed to earmark and preserve all federally owned wilderness, the Service accelerated its field surveys. It completed studies in Shenandoah (Virginia), Isle Royale (Michigan), Petrified Forest (Arizona), Kings Canyon (California), Sequoia (California), and Lassen Volcanic (California) national parks; Craters of the Moon (Idaho), Pinnacles (California), and Lava Beds (California) national monuments, and in Cumberland Gap National Historical Park (Tennessee). Of the 1,934,000 wilderness acres studied, the Service is proposing 1,075,000 for designation in the National Wilderness Preservation System. The Service objective is preservation of large areas of wilderness surrounded by a natural setting of wilderness thresholds.

Public hearings held during the year brought a variety of views favoring more, or less, wilderness acreage. The Service considers all views carefully before formulating its final recommendations. The wilderness studies are expected to continue seven more years. In some parks the Service is restoring former wilderness areas to their wilderness character.

The NPS Plan is a master concept for a comprehensive National Park System. Studies show that some significant national and historical themes are not represented in the Park System. Thus, more than 100 new areas have been suggested for addition to the System to provide authentic examples of our natural and historic heritage.

The Service looked critically at 120 potential Natural Landmarks, finding only 28 with the necessary requisites for the National Registry of Natural Landmarks. Since Secretary Udall established the Registry in 1963, the Service has approved 82 places in 31 states. An example of the rare sites approved during fiscal 1967 is Dysart Woods, owned by Ohio University. It contains 40 acres of virgin white oaks, some of them contemporaries of trees that supplied the Navy's masts early in the 19th century.

Under Service chairmanship, a Federal committee on Natural Areas is stressing a program to develop a Registry of Natural Areas for Research. The Service will administer publication of this register, now being readied to include 56 NPS areas and 279 areas under other Federal agencies.

Environmental Design Division Created

A new Division of Environmental Design in the Park Service family operates in an atmosphere of quiet excitement. Engineers and architects study how to move people—physically as well as aesthetically. These experts speak a language of monorails, conveyors, tramways, and self-propelled modules. They seek a silent, efficient way to transport people unobtrusively through the national parks without making it necessary to carve nature's grandeur into more highways and parking lots.

A tramway has been approved for Glen Canyon National Recreation Area (Utah-Arizona), and another is being considered for Guadalupe Mountains National Park (Texas). The purpose is to lift people quietly to where they can enjoy majestic scenery and experience nature in a series of climatic zones at various levels.

As efficient, short-range substitutes for highways, tramways will spare man—the traffic-endangered species—an annual toll of highway death and injury, a steady source of carbon monoxide air pollution, road jams and parking problems, not to speak of the traffic management headaches of the park rangers.

"Roads full of cars constitute serious ecological barriers in the national parks," reports the Division of Environmental Design.

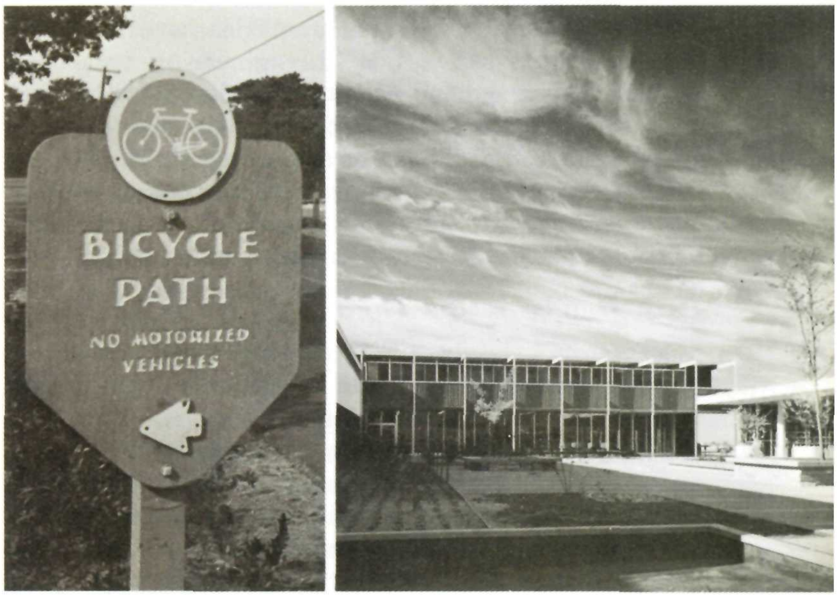
Established in 1966, the division was assigned to study the challenges of our changing environment and to propose philosophies and developments to meet these challenges. It sent experts to comb Europe for the latest transportation research and techniques.

Personally operated conveyors may be the next major transportation breakthrough in the national parks. Conveyors now used by industry for removing ore have been converted experimentally into self-propelled vehicles whose wheels clasp steel rails capable of ascending to dizzy heights. The equipment can be blended smoothly into the landscape. Each conveyor has its own electric power. The engineers call the vehicle "a people-carrying module," a term for a compact assembly operated as a component of a larger unit.

The designers are convinced that such methods are necessary to relieve the glut of automobiles which discourage full visitor enjoyment of the national parks. Other methods may be necessary where distance makes tramways or conveyors uneconomical. In Yellowstone National Park (Wyoming-Idaho-Montana), where as many as 10,000 cars a day may clog the road to Old Faithful Geyser, NPS is proposing one-way "nature roads" to divert traffic to other destinations.

© National Geographic Society

A Great Smokies highway, a Cape Cod bike path, a visitors' center in the Petrified Forest, all play parts in "Environmental Design, 1967."



As winding and scenic as an old country lane, the "nature road" would provide older, or less active nature viewers with ringside seats while moving at a leisurely pace. Nature roads also would carry out environmental techniques which NPS has used in constructing the Blue Ridge Parkway in Virginia and North Carolina and the Foothills Parkway in Great Smoky Mountains National Park (North Carolina-Tennessee).

The cost of environmental design should be measured in terms of natural beauty saved, with interest compounded annually for untold generations of Americans. The Service is placing 20 miles of power lines underground rather than stringing wires across Everglades National Park's subtropical wilderness in Florida. This will prevent power poles and cables from blotting out the silhouettes of cabbage palms against the sky. The underground line will cost $250,000 more than the surface swath across the landscape—a small price to prevent a permanent 20-mile scar on the unblemished Everglades.

"Environmental Design, 1967" also left its marks elsewhere in the Park System, including Petrified Forest National Park, in Arizona, and Glen Canyon National Recreation Area in Utah and Arizona.

In Petrified Forest National Park, the rugged environment shapes and directs the installation of facilities. The imaginative design of the Painted Desert Community takes inspiration from the sweep of sagebrush, sand, and rock, the functional simplicity of the ancient pueblos. For defense against the desert winds, the park headquarters and visitor reception and employee residence structures are turned inward.

The environment stimulated similar inventiveness at Glen Canyon National Recreation Area. Boatloads of visitors swarmed across Lake Powell to within a mile of Rainbow Bridge National Monument (Utah). The canyon walls they encountered were majestic in their beauty but the towering shoreline permitted no practical landing.

Since conventional boating facilities here would not be compatible with scenic or engineering principles, engineers designed and built boat landing islands. They anchored the island complex in a bay near Rainbow Bridge. The complex has a floating ranger station, restrooms, a camping supply store, and a refueling station. In the shadowed waters of the canyon walls, the manmade islands are relatively inconspicuous.

Park Hands Across The Sea

NPS works closely with park authorities in all levels of government, with private conservation and recreation groups, and with private industry. Its park practice program, conducted with the National Recreation and Park Association, provides teaching and reference assistance to universities and foreign countries. The latest advances in park administration and management are circulated widely through the Service's park practice publications: "Design," "Guidelines," "Grist," and "Trends."

As befits an institution which has encouraged the national park idea in more than 80 nations, NPS continues to expand its international program. The basic purpose is to advance United States foreign policy objectives in cooperation with the Department of State. The effects, however, are ecological and economic, scenic, and recreational. In a steaming classroom of the College of African Wildlife Management at Mweka, Tanzania, a Park Service instructor teaches natural history as part of an Agency for International Development project. By the time he finishes his assignment, students of 10 African nations have learned how to identify native plants and animals, and their ecological relationships.

The Service's Division of International Affairs sent one of its top administrators as national park adviser to New South Wales, Australia, at the request and expense of the Australians. A three-man park planning team assisted Tanzania by evaluating its proposed Mount Kilimanjaro National Park. A similar team responded to a request from Ethiopia to study that country's national park, conservation, and historic site possibilities.

An exchange-of-information program with Japan on national park management is proving of mutual gain. More than 150 trainees from other countries have benefited from the special training programs of the Service and its national parks course at the University of Michigan.

The price is high for an environment containing sufficient and accessible parks for nearly 200 million people. In fiscal 1967, the NPS paid $33,680,000 for 31,452 acres necessary to round out 38 areas of the National Park System in 22 states.

The high cost of park land in our acquisitive society is endangering the proper expansion of the National Park System. Yet a nation whose parks are a virtual necessity to the well-being of its people cannot afford the false economy of the status quo. Legislation permitting swifter acquisition of authorized parklands through an enlarged Land and Water Conservation Fund was submitted to Congress during the year.

The golden sands of our seashores are perhaps more than a figure of speech. To acquire 235 miles of the nation's 60,000 miles of shoreline—about two percent of which is in public ownership—the Service paid $7 million. Prices ranged from about $5,400 per acre for 149 acres at Assateague Island National Seashore (Maryland-Virginia) to $2,800 an acre for 1,003 acres at Fire Island National Seashore (New York), more than $1,000 an acre at Cape Cod National Seashore (Massachusetts), and slightly less at Point Reyes National Seashore (California).

The acquisition of inholdings—properties which private owners retain within national park areas—is essential to the full realization of scenic, natural, and historical values of many parks. In one western national park, a 75-foot private lot with a growing trash pile and unsightly shack on the shore created an eyesore. Its acquisition by NPS added little to the country's total recreational acreage, but when it was restored to its natural beauty, the lot added significantly to the integrity of a great national park.

History and Archeology

The Historic Preservation Act of 1966 became the third of three great laws under which the NPS safeguards America's historical heritage. The others are the Antiquities Act of 1906 and the Historic Sites Act of 1935. The new act authorizes many more sites on the National Register and could greatly enhance the American environment.

Through its grants to the states, communities now may preserve sites and buildings that are worthwhile and attractive, as well as historic. The Service assists in evaluating the sites. Each salvaged site can be the nucleus for designing or redesigning a community with spatial interludes of historic and architectural grace.

The Act established a 17-member Advisory Council with the Director of the National Park Service as Executive Director. The Council assists the President and Congress. When material progress and historical preservation values conflict, the Council provides a forum for resolving the difference in the public interest. If plans for any Federal project, including expressways, dams, dredging, or buildings, threaten a National Register site, the Advisory Council must be given the opportunity to express its views.

Historic sites are disappearing like pages torn from a book. To save areas threatened by superhighways, urbanization, dams, and irrigation projects, the Service participates in an Interagency Archeological Salvage Program. The Service arranged for the University of Pennsylvania, in cooperation with the state highway department, to salvage early colonial and Federal sites in the path of the proposed Delaware Expressway through Philadelphia. This was the first large-scale highway salvage effort conducted in a metropolitan area.

The Service added significantly to the storehouse of man's scientific and historical knowledge by producing or sponsoring 232 research reports, publications, articles, and manuscripts, 114 of them on archeology, 45 in the natural sciences, and 73 in history.

Another major historical responsibility devolved upon the Service in 1966 under a congressional resolution establishing an American Revolution Bicentennial Commission. Congress authorized the Secretary of the Interior to study Revolutionary War sites and recommend action necessary to prepare the sites for appropriate ceremonies in 1976. Within a year, the Service had nearly completed a study of 42 significant areas.

To meet the new historical responsibilities and the sharp growth of the National Park System (22 areas added by the 89th Congress alone), the NPS top echelon was reorganized to include a deputy director, an Office of Archeology and Historic Preservation, and an Office of Natural Sciences

How great is the people's interest in their parks? They devour National Park Service publications by the millions. The 1967 NPS *Campground Directory* brought 700 requests a day from vacationing America, reflecting the sharp rise in national park campground use. Since 1956 the number of camper days (one camper staying one day in the Park System) has nearly tripled —from 3.6 million to 9.4 million in 1967. The opening of 41 additional park areas in the 1960's has increased the available campgrounds.

The year signaled the approach of a historic new technique in managing national parks with the help of space satellites. Project EROS will gather information on the park environments through sensitive instruments carried on Earth Resources Observation Satellites (EROS). The first launching is scheduled for 1969. NPS is confident that EROS will mark a new era in park management by monitoring ecological conditions in the Florida Everglades, detecting insect damage to trees in the Pacific Northwest, extending glacier research, detecting water pollution and sources of potable water, predicting volcanic eruptions and earthquakes, and recording thermal differences.

Thus will man use the environment of outer space to study the surroundings of man and the thin crust of earth he inhabits.

Geological Survey

The Geological Survey helps shape a quality society for increasing numbers of Americans by its continuing studies, investigations, and research of our renewable and nonrenewable resources. Significant contributions to scientific information stud the past, and today every activity aims at developing new basic knowledge of our natural resources. Such knowledge is essential to a sound public program for conservation and wise use of minerals, water, and land resources.

A sophisticated new tool for dealing with resources problems was announced by Secretary Udall in September 1966—the Earth Resources Observation Satellite (EROS) program. The project is designed to gather, with precision and economy, new facts about the world's natural resources. Earth-orbiting satellites carrying remote sensing observation instruments are the heart of the program, which is being carried out cooperatively with the National Aeronautics and Space Administration (NASA), the Department of Agriculture, and other government agencies.

Although many of the studies have geologic and hydrologic goals, resulting facts are applicable to other fields of interest falling within Commercial Fisheries, Mines, National Park Service, Land Management, and other bureaus of the Department.

The Geological Survey is helping in the development of aircraft and spacecraft instruments to observe reflected ultraviolet energy, ultraviolet stimulated luminescence, emitted infrared radiation, reflected radar energy, and the magnetic field of the earth. The Survey also is working with the Department of Commerce in defining camera systems which, when flown in satellites, will make possible the updating of our national topographic maps.

A basic set of performance specifications for a general-purpose resources satellite has resulted from the Survey's studies. Such a satellite can carry high-resolution television cameras that look through narrow spectral bands in the visible or near-visible spectrum. The television sensors will provide information on the configuration of terrain, including the land under water, and the distribution of water as free water and moisture. These same sensors also will provide information on distribution of vegetation, vigor of vegetation, presence and location of alien fluids within water, and coloration of rocks and soils.

A recent infrared survey of the periphery of the Island of Hawaii, made by means similar to those proposed for EROS, has stirred world-wide interest. Because the temperature of fresh ground water differs from the temperature of the ocean, the Geological Survey was able to map the distribution of approximately 250 springs that flow into the ocean from the island. In effect, this is lost water—hundreds of millions of gallons a day. The mapping has made it possible to plan ways to contain this underground fresh water before it is lost into the salty ocean.

Iceland Volcano Surveyed

Using infrared techniques, Survey scientists and the Air Force Cambridge Research Laboratories, Bedford, Mass., made an unusual 3-dimensional study of Iceland's Surtsey volcano last year. Ground and aircraft observations of Surtsey were supplemented with infrared information obtained from the Nimbus II orbiting satellite which passed over Iceland repeatedly during the summer of 1966. The study marks the first time volcanic heat has been monitored almost simultaneously from the ground, aircraft, and outer space. It also has provided scientists with a yardstick for calculating amounts of heat radiated from a volcano to space. This ability to determine heat radiation could be applied, geologists believe, to studies of volcanoes elsewhere on the earth, moon or planets through infrared devices in space vehicles. Infrared imagery, such as that obtained in Iceland, will assist geologists who are studying the timing of volcanic eruptions and may help in determining the predictability of eruptions.

One of the initial objectives of the EROS program is to produce a photo-image map of the world. Secretary Udall, in describing a mosaic of space photographs of Peru taken on a Gemini flight and recently compiled by the Geological Survey said:

"This mosaic covers roughly a third of a million square miles. In just one pass, the Gemini astronauts photographed almost 80 percent of Peru; it took just three minutes. The scientists, who have seen this mosaic, consider it to be superior to any available map of the region in terms of information conveyed. One can see the gross patterns of land use, distribution of snow, the levels of the lakes, geologic features of possible economic significance—all at a single glance . . . the value of such mosaics in planning the development and use of lands is so great that I believe we ought to do more of this kind of work."

The highly industrialized civilization the people of this nation now enjoy and are continually striving to improve is based to a large degree on the ability to find and use efficiently the mineral wealth of the land. Many minerals and metals essential to our industrial economy are being consumed in the United States at rates exceeding domestic production. Mounting requirements caused by increases in both standards of living and numbers of people are creating a worsening supply situation.

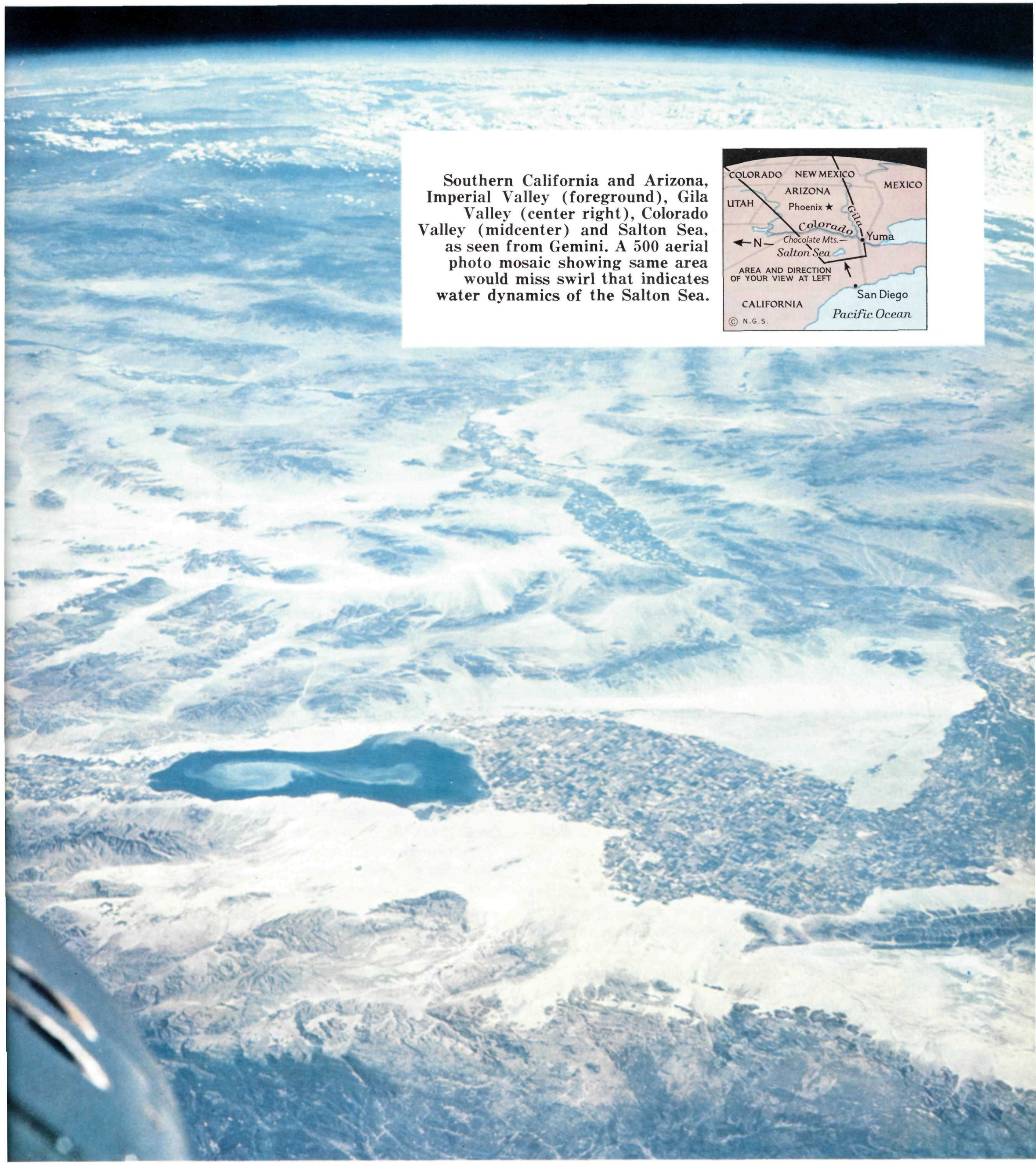
Some metals now in critically short domestic supply are constituents of many familiar things—precious metals in jewelry, tinplate in containers, silver in photographic film, and nickel in stainless steel. Demand for these metals is aggravated by the ever-increasing space-age needs, especially for gold, silver, and tantalum.

Heavy Metals Program Launched

New sources of minerals and metals must be found to close the widening gap between domestic production and consumption, and to insure adequate future supplies. In mid-1966, the Geological Survey, in cooperation with universities and oceanographic institutions, began a program to locate new sources of supplies for such heavy metals as gold, silver, platinum, mercury, tin, antimony, nickel, and tantalum. New environments and host rocks are being studied as possible sources on land and on submerged shelves bordering the continent. Although this program has been underway only a year, important results have been achieved. For example: At Cripple Creek, Colo., samples from an area 3,800 feet long and 500 feet wide indicate a potentially large low-grade deposit of gold; areas favorable for the accumulation of black sands containing gold, platinum, and chromite have been identified in the coastal region of southern Oregon and northern California, using subbottom acoustical profiling methods.

Continuing Survey programs have located many areas worthy of further exploration.

Federal lands, subject to lease under the Mineral Leasing Act, are evaluated and classified by the Survey as to the potential for water resources development, and for "leasable" minerals such as coal, oil, and gas, oil shale, phosphate, potash, and sodium compounds. Classification of lands with potential resource value



Southern California and Arizona, Imperial Valley (foreground), Gila Valley (center right), Colorado Valley (midcenter) and Salton Sea, as seen from Gemini. A 500 aerial photo mosaic showing same area would miss swirl that indicates water dynamics of the Salton Sea.

© National Geographic Society—NASA Photo automatically imposes controls designed to permit the best use of these lands. The purposes approved must be compatible with future water and mineral development, and must prevent loss of the resources through land disposal to private interests. The Survey also insures that the resources on Federal lands and all mineral resources on the Outer Continental Shelves are efficiently developed for the entire nation and with minimum adverse impact on the environment.

The Survey is concerned that mineral operations under lease on Federal lands do not cause avoidable pollution of the air or water and that all possible measures are taken to restore or reclaim the surface resources of the land disturbed by such operations as strip mining.

Areas of Federal lands, the Outer Continental Shelves, and the great deposits of undeveloped oil shale and associated minerals on Federal lands in Colorado, Utah, and Wyoming are of public interest because they hold promise of substantial contribution toward satisfying future demands for energy and agricultural and industrial raw materials.

Geophysical Projections Useful

Urban development and other construction work continue to expand into areas susceptible to natural hazards such as earthquakes, floods, and slides. The Geological Survey provides a continuous, systematic analysis of U. S. regional geology as a broad framework for all our land use and conservation problems as well as for detailed mineral resource appraisals.

In this program, geologists examine and sample rock outcrops to determine their distribution, structure, and size. Geophysics enables the geologists to project information to great depths; geophysical surveys measure the regional variation in the earth's gravity, its magnetic field, electrical resistivity, and other properties. Some of these surveys can be made with airborne equipment. Aeromagnetic surveys in particular are almost fully automated. These regional analyses are published as geologic maps and reports.

One of the largest of the studies is a cooperative program with the Kentucky Geological Survey for detailed geologic mapping of that entire state. The federal Geological Survey is conducting similar cooperative programs in several eastern states where population densities have created pressing land-planning and management problems.

Supplementing these broad regional analyses are investigations of smaller areas prone to natural hazards, chief among which are earthquakes. Ways to live safely in earthquake-prone areas are being sought by the Survey through studies of active fault zones of the western United States. Scientists from the newly established National Center for Earthquake Research in Menlo Park, Calif., are using seismographs, tiltmeters, strainmeters, magnetometers, and gravity meters to detect the tiny earth adjustments associated with small quakes. Patterns of movement along the faults are under investigations which may lead to methods of earthquake prediction. A new high-pressure, rock-deformation laboratory makes it possible to study how rocks actually fail when an earthquake occurs.

A network of seismic recorders established by the Survey along portions of the San Andreas and Hayward Faults, together with those operated by other research groups, will permit scientists to dissect and diagnose any earthquake, large or small, that may occur within the system of networks. Other current earthquake-engineering investigations concern soil mechanics, ground motion from earthquakes, and the geologic characteristics of fault zones.

Construction problems also emerge in areas of unstable ground such as cavernous limestone with hidden sinkholes, swelling and contracting clays, artificial fill, permafrost, and lands susceptible to slides. Such areas are subjects of engineering geologic research to develop new methods of approach and ways to apply earth science data to urban problems.

Planning of airports, highways, dams, pipelines, industrial plants, and countless other types of construction, depends heavily on the topographic maps prepared and published by the Geological Survey. These maps show location and shapes of mountain valleys, and plains, networks of streams and rivers, and principal works of man. They facilitate the study and application of flood control, soil conservation, and reforestation, and are an essential part of geologic and hydrologic research mineral investigations, and studies on the quantity and quality of water.

Outdoorsmen Turn To Maps

The rapidly growing list of map users now includes not only scientists, engineers, and managers but also many people who have discovered the advantages of topographic maps in such outdoor pursuits as camping, hunting, fishing, and hiking. Reliable maps showing relief features, woods, clearings, and water-courses are of inestimable value to nature enthusiasts. In the past year, the Survey published more than 2,000 new topographic quadrangle maps and sold nearly 7.5 million map sheets.

The Geological Survey's new nationwide computing system, centered in Washington, D. C., expedites work in volcanology and earthquake studies, earth-orbiting satellite surveys, lunar geology studies, the national topographic mapping program, minerals investigations, hydrologic studies, and work on the National Atlas.

Telecommunication circuits connect computers in field terminals in Denver, Colo., Flagstaff, Ariz., Rolla, Mo., and Menlo Park, Calif., with the master computer in Washington. They comprise a nationwide computing system which enables scientists and engineers to submit data from field terminals and to receive printed results from the central computer in Washington in a very short time.

This computing system has speeded the development of equipment and techniques for automating some of the topographic mapping processes.

A recent achievement in instrumentation was the development by Geological Survey engineers of a new system of viewing aerial photographs in three dimensions. Called the "Stereo Image Alternator" (SIA), it permits the use of color photographs with double-projection type stereoplotters.

The production this year of a series of photomaps of the Okefenokee Swamp area, Georgia-Florida is an event in the history of U. S. mapping. These photomaps, while retaining the accuracy of standard topographic maps, give detailed terrain information heretofore available only on aerial photographs, and are especially useful in water resources studies.

Published topographic maps now are being revised to show man-made changes and additions that have taken place since the original maps were published. These maps will be especially valuable in rapidly expanding urban-suburban areas.

The Survey is continuing its mapping activities of Antarctica as part of the international cooperative effort to learn more about the resources of this little known continent. By 1975, mapping of the mountainous areas and selected portions of the coast of western Antarctica will be completed.

Understanding of Land Needed

National concern for environmental deterioration arises in considerable measure from an imperfect understanding of the interaction of man and his environment. Need for geographic knowledge is a function of the extent of the land, its benefits, the resources it contains, the diversity of its characteristics, and man's present and projected activity.

As a research source for geographic data, the 475-page *National Atlas of the United States of America* being prepared by the Geological Survey will provide an accurate, composite record of the physical environment of the country, its resources, economy, industry, population history, and other facts. The objective of the National Atlas program is to provide in a single 14- by 19-inch volume a reference tool not heretofore available for the United States, and to revise the atlas every 10 years. The atlas culminates more than a decade of planning and cooperation among federal agencies.

Five maps already have been published and are available for separate sale. These are Geology, Population Distribution, Monthly Sunshine, U. S. Land-Surface Form, and Alaska Land-Surface Form. About 300 pages of the atlas are in some phase of preparation. The physical and historical sections, consisting of approximately 150 pages each, are the most advanced.

Hydrologists of the Water Resources Division work constantly collecting facts about the flow of streams, fluctuations in water levels, and the quality of surface and ground waters. Through its Hydrologic Data Network, maintained in cooperation with state and local agencies and other federal agencies, the Survey collects water resource data from more than 8,400 stream-gaging stations, about 16,000 groundwater observation wells, and more than 2,200 water quality stations. Knowledge gained from this work is used by the federal government, and states and municipalities all over the country in an effort to bring about environments that contribute to man's physical and spiritual well-being.

Many improved methods of collecting water information were put into operation during the past year. For example, automatic data recorders now installed on many streams shorten the time between collection and publication of water data. These recorders can transmit information by telegraph or telephone at regular intervals, or by special command.

Atoms Put to Water Work

One example of research being conducted to perfect new ways of collecting water information involves atomic energy. The Geological Survey has installed a new TRIGA Mark I nuclear research reactor at its laboratory in Denver, Colo. A major use will be to bombard samples of water, soil, and rocks with neutrons. This bombardment radioactivates many of the chemical elements in a water sample. By analyzing the types, energies, and intensities of the sample's radioactivity, the concentrations and identities of elements present only in extremely small quantities can be determined. The method also can be used to identify and measure pollutants in water.

To assure effective and economical management of our nation's water resources in meeting essential user requirements, the Survey's Office of Water Data Coordination (OWDC) pulls together those Federal activities that acquire water data from streams, lakes, reservoirs, estuaries, and ground waters. The OWDC has prepared a *Catalog of Information of Water Data,* which is a guide to the collection of water data throughout the country and can serve all water data users. Access to the catalog is provided through an index which enables the user to decide if the types of information available will serve his needs. The 1967 edition of the index was scheduled for completion by the end of that year.

Hydrologists and sanitary engineers long have sought better ways to define the ability of a stream to recover deficiencies of oxygen (reaerate) as it flows along. Streams with low dissolved oxygen content kill fish and other beneficial organisms, tend to contain many harmful bacteria, and have an unpleasant odor. A technical report, *The Aeration Capacity of Streams,* results from a Survey study which shows how to predict a stream's ability to reaerate. This information will assist the Department in classifying streams as to water quality under the water pollution control program.

Several years of federal-state-financed study has produced a comprehensive report describing water-bearing rock formations underlying about 90,000 square miles in South Carolina, Georgia, Florida, and Alabama. These rock formations supply more than 2 billion gallons of water daily, through wells, to Florida and parts of the other three southeast States. The investigation has disclosed that this underlying aquifer system is capable of yielding much more water than it now is producing. But orderly scientific controls of withdrawals will be needed to avoid local depletion, or contamination as a result of encroaching sea water or the indiscriminate disposal of wastes. Survey experts are constructing an electric analog model of the aquifer to work out control measures.

Temperature Study Published

The first nationwide report on surface water temperatures in more than 40 years was published last year by the Geological Survey. This report, *Temperatures of Surface Water in the Conterminous United States,* with its multicolored maps, provides facts for agencies and individuals involved in water pollution control, and water development and management problems.

The Geological Survey continues as a participant in the International Hydrologic Decade, (IHD) launched in January 1965. This is a cooperative effort by many countries to learn more about the world's water and how to use it. Its ultimate purpose is to overcome the now-existing critical deficiency in hydrological knowledge on a global scale. The United Nations Educational, Scientific and Cultural Organization (UNESCO) provides an official coordination committee to the IHD.

Each year the Survey publishes the results of its research and scientific investigations in hundreds of books about geology, hydrology, and related sciences, as well as thousands of maps of various kinds. Some of the Survey's publications are prepared in cooperation with the various state and local governments, with federal agencies, and with universities, such as the long-range project to provide geologic quadrangle maps covering the entire State of Kentucky.

Although many of the Survey's publications are intended primarily for the scientific community, a significant proportion can help the layman to understand his environment better. To be completed next year is the series of detailed reports about the Alaska earthquake of 1964, now being published by the Survey. This series is one of the most comprehensive analyses of a single earthquake ever published.

Floods, too, have been studied by the Geological Survey, and some of its new publications, such as the series of hydrologic atlases detailing floods in northeastern Illinois, point the way to development of protective measures.

The work of the Survey is not limited to our own shores. For more than 25 years the Geological Survey has provided developing nations, at their request, with technical assistance in appraising their natural resources and in training their earth scientists. During Fiscal 1967, the Geological Survey provided 134 specialists to 30 countries and arranged academic or practical training in the United States for 94 earth scientists and engineers from abroad.

Some of the Survey's recent publications have been aimed at helping other nations achieve greater prosperity. For example, a series of seven new professional papers on the geology of the Arabian Peninsula serves to amplify and describe the geology shown on the Arabian maps that the Survey published several years ago.

Some Maps Out of This World

Indeed, the Survey's publications are not even limited to our own planet. Ten of the 44 geologic maps covering most of the moon's visible surface have been published. These maps show the distribution and relative age of the various lunar surface materials that can be identified, and the many visible craters.

This mapping program is part of a series of projects the Geological Survey is carrying out in support of the NASA program of space research. The Survey's work consists of lunar geologic mapping; studies in cosmic chemistry and petrography (meteorites, cosmic dust); geologic study of terrestrial analogs of lunar features; and development of research instruments and techniques needed to support effective geologic exploration of the lunar surface.

On the basis of high-resolution photography obtained from the missions of the Lunar Orbiters and Surveyor I and III, the Geological Survey has recommended prime sites for the first Apollo moon landing. The photographs and other information have shown that lunar surface materials will support Apollo landing spacecraft and that man can walk over the surface, leaving footprints not more than a few inches deep.

Bureau of Land Management

As caretaker of 457 million acres of open space, the Bureau of Land Management (BLM) manages these great expanses for maximum usefulness. The lands are held in trust for all Americans and are what might be termed "human life refuges." They provide escape from the threatening forces of pollution and crowding. Their expansive wildness is, in a sense, man's "last frontier."

Over the years, the United States at various times has held title to about four-fifths of the Nation's gross area, 2.3 billion acres. Now only a third remains, 60 percent of it in public domain land managed by BLM. This land is extremely valuable, not only for recreation but as a storehouse of natural resources which help assure the continued growth of a Nation dependent

Photo by Jim Lee

Livestock is a renewable resource. Here, sheep graze on public lands in Colorado.

upon them. Their wildlife, minerals, forests, and waters comprise an asset pointing to a more secure future.

The Western States, especially California, have experienced greatly accelerated human and economic growth in the past decade. Population pressures have created an unprecedented need for residential, business, commercial, and industrial development. Uncontrolled urban sprawl has left ugly scars across the landscape.

BLM cooperates with state and local governments and private organizations in planning orderly use and development of public lands. Through the Classification and Multiple-Use Act, and programs under the Public Land Sales Act, BLM encourages local governments to plan together for community growth, especially where public domain lands are needed for expansion. To aid this cooperative effort, BLM requires that all land disposals proposed by the Bureau be consistent with local planning and zoning. The object is to discourage the planless dissipation of open space—at least on the public domain lands—and by example and cooperation to encourage better use of adjoining private lands.

Man is largely a product of his environment. When it languishes so, to a degree, does man. In a pleasing environment with opportunity for growth, his opportunities for quality performance increase.

Improvement of the social as well as the physical environment is encouraged by the practice of assisting state and local development. State schools and road systems have received major support from a program of conferring upon states—at the time of their admission to the Union—tracts of public domain land to support public purposes. This policy has resulted in the transfer of 100 million acres of land from the public domain to the states for support of schools and other institutions.

Today the program of outright grants to the states is being closed out in the lower 48 states with programs to satisfy remaining rights. The State of Alaska has until 1985 to select the large acreage to which it is entitled. Other programs of assistance include free rights-of-way, leases and sales of lands under the Recreation and Public Purposes Act at nominal prices, and share of Federal revenues.

Mineral Development Objectives

BLM's twin objectives involving minerals are (1) to help meet the national need for minerals at reasonable costs, and (2) to meet these needs without serious harm to our environment.

Most resource studies and analyses conclude that it will be possible to meet most of our needs for minerals without large increases in cost, possibly up to the year 2000. However, these studies are based upon a number of variables, such as the availability of foreign supplies, continued technologic advances, continuation of past trends in discovering mineral deposits, and the past level of public concern for environmental problems.

Fortunately, the public lands—including the offshore shelves—constitute a substantial reserve of both known resources and areas for further exploration. One example of a known deposit is the oil shale reserve of the Green River formation in Colorado, Utah, and Wyoming. Depending on the grade used for a minimum cutoff, the deposit contains trillions of barrels of shale oil locked in the shale rock. About 80 percent of the richer, thicker deposits is publicly owned. Good quality shale deposits are known to contain at lease twice as much as the world's proved petroleum reserves. These deposits provide a logical substitute for conventional petroleum to meet the tighter supply situation which some view as likely toward the end of the 20th Century. These oil shale deposits constitute the Nation's largest known but untapped natural resource.

Examples of public mineral resources which await discovery by exploration are the minerals of the Outer Continental Shelves (OCS). Over $2.5 billion have been received in the form of bonuses, rentals, and royalties from OCS oil and gas leases. Over half a billion dollars were collected in bonus bids from one sale in 1967. Oil production on OCS, which started in 1953, now constitutes about 5 percent of total production, and the percentage is increasing. Most of this production has come from the Gulf of Mexico, but interest is increasing off the West Coast and Alaska. The OCS area also has large potential for other minerals.

The Department is trying to improve the management of all publicly-owned mineral resources by:

1. Revising regulations to protect surface resources and to prevent pollution which might follow mineral exploration and production.
2. Submitting legislation to provide for the recordation of mining claims in the Land Offices. This legislation would eliminate the cloud on the title to millions of acres of public lands from abandoned claims presently of record only in the county offices and would provide an orderly procedure for recording new claims.
3. Asserting prorationing and conservation authority over offshore oil production.
4. Increasing economic and other studies of proposals to improve income and management procedures.
5. Strengthening enforcement of the mining laws to prevent their misuse by persons attempting to obtain control over recreation sites and other nonmineral resources.
6. Increasing emphasis on full consideration of known and potential mineral areas in the Bureau's analyses and management plans.

The harmonizing of mineral development with other resource values is one of the major challenges facing Congress and land administrators today in the field of public land law.

BLM studies indicate that for many minerals, the share contributed by Federal lands will increase. They also indicate that by positive management, most environmental problems can be held to acceptable minimums. However, if all public goals are to be met, some modernization of laws will be required.

Range Management Practices

The livestock industry that is dependent upon the public lands is, in a sense, a renewable resource. Increased production is a central feature of BLM range management programs. Multiple use is the revitalizing principle: today the land manager and rancher are also looking to the public ranges for wildlife habitat, recreation, and a sustained flow of clean water.

Intensive management principles applied to each of the 12,770 grazing allotments will permit grazing to continue on a sustained-yield basis in harmony with other uses and public values of the public lands.

BLM's new range-management program aims at effective "on-the-ground" monitoring of the forage resource to promote soil stability and good water-shed conditions. Rest-rotation grazing and other forms of grazing management systems are supplying new answers to old problems.

Less effort is being directed toward record-keeping and the legal aspects of range management; more is going into improving the condition of the land. In accomplishing these goals, the cooperation of nearly 25,000 ranchers, who now graze 3.5 million cattle and 1.5 million sheep annually on the public lands, will be required to integrate livestock grazing with other uses. Mutual cooperation under which the rancher manages his livestock in accordance with these multiple-use plans, and the improvement of private range land used with the public lands will dominate the conservation scene on the public rangelands.

Forests are a many-faceted resource. In addition to products and services, they provide sanctuaries from man's own throbbing progress. Where their abundance was once viewed as an encumbrance to progress, that very progress has created a scarcity of forests, a condition that endangers the existence of that quality of life man has come to value and respect.

Not only are needs for wood fiber growing; demands on the forest for other uses are keeping pace with the steady growth of a population that has more leisure time and craves more recreation in the forests.

BLM practices forest management on 39 million acres of public lands covered with commercial forests which are now, or have the potential of, growing timber as a sustained, perpetual crop. It also manages another 108 million acres of woodlands. These lands are important for soil stability, watershed protection, wildlife shelter, and forage, as well as for many minor products from fence posts to Christmas trees.

Now in progress is a comprehensive study, *Guides to Land Management.* Focused on allowable cuts and increased timber production in western Oregon, its concepts and techniques eventually will be adopted for all the Bureau's forest lands.

Through computer methods, the impacts and end results of alternative forest management policies can be measured over periods of two or more forest generations.

Soil and Watershed Conservation

Conservation of soil and water is vital to the perpetuation of man's environment. Soil productivity is necessary for sustained yield production of vegetative materials, which, in turn, are converted to meet man's food and fiber requirements. Water is an essential commodity for this process as well as for man's direct consumption, industrial production, recreation, and disposal of waste materials.

Use practices which injure the delicate balance among vegetation, soil, and climate, can start a cyclic series of relationships that eventually will do irreparable damage.

In addition to decreasing yields of timber, forage, and cultivated crops, attendant off-site damage results as the natural watershed deteriorates. Water-transported soil particles lodge in storage reservoirs and reduce their capacities; stream channels are clogged, hindering navigation and increasing flood damage; canals are choked with sediment, restricting flows, and wasteful, water-consuming plant growth is encouraged.

Soil and soluble solids washed from the land detract from water quality, and make necessary expensive treatment of the sediment and salt-laden water before it can be used for municipal, industrial, and even agricultural purposes.

To perpetuate its own existence, society must accept soil and water conservation as a mandatory prerequisite to land use. Urban developers, highway engineers, and all other users of the land must recognize the need for protection of soil and water resources, and must design programs and plans accordingly.

In relation to food and water requirements of projected populations, the importance of soil and watershed conservation programs for the arid and semi-arid public lands cannot be underestimated. Because it may take several hundred years to rebuild a soil, it is realistic to protect even the most arid lands against some future time when technological development (possibly in the form of weather modification or water importation) may permit their use.

Recreation

The amount of land does not increase, but people and automobiles constantly do. And so there is increasing pressure for recreation opportunities. This competition for land presents a challenge to the Bureau of Land Management as visitors from all over the Nation overflow the boundaries of parks and forests, and spread over the public domain. In their hunger for the outdoors and their search for new and different recreation experiences, they have found the public domain a rich, untapped reservoir of opportunities.

BLM's role as a supplier of recreation opportunity is threefold. It must supply supplementary recreation opportunities near national parks and forests, other opportunities within short driving time of the large western urban centers, and opportunities for those who are trying to get far from crowds and traffic.

Protection of the environment is a part of every management decision. The great variety of latitudes and elevations on the public lands offers a potential for wider seasonal use at times when many of the national parks and forests are closed by snows. Such increased seasonal use requires new planning concepts—such services as provision of proper sanitary facilities and clean-up litter are but part of the task. Protection of vegetation in the development of roads, trails, and campgrounds is another primary consideration.

In its recreation plans, BLM is coordinating its efforts with all levels of government and with private interests.

BLM has completed its first recreation inventory, and has identified more than 4,300 potential sites. Approximately 150 of these now are developed for public use. An estimated 6.2 million acres of land have primary values for recreation. These include mountain meadows, streams, scenic corridors, roadside park sites shores of lakes and reservoirs, and desert campsites of the Southwest.

Facilities for handling more than 2,000 camping families at one time have been developed. By 1973 the Bureau hopes to provide intensive-use facilities for an estimated 11.6 million visitor-days annually. To create a greater recreation opportunity for urban dwellers, BLM is emphasizing developments within two or three hours' drive of a half dozen western metropolitan centers.

The Bureau is giving highest priority to developing recreation opportunities in areas of national and regional significance, and in areas where public recreation demands are not being met by other means. BLM's goals in providing outdoor recreation opportunities include:

1. Continuing inventory and assessment of recreation values.
2. Timely and orderly utilization of recreation resources through proper planning.
3. Responsive level of development in areas of need.
4. Development of adequate information on recreation use and demand.
5. Provision of an effective information and interpretive program.
6. Cooperation, coordination, and participation with other units of government and private interests in outdoor recreation studies, planning and development.

Wildlife on the Public Lands

In recent years there has been an increasing public awareness that the quality of fish and wildlife habitat is a reflection of the quality of man's environment. The commercial use of public land resources continues as it must, but measures designed to protect fish and wildlife habitat are being incorporated into these uses.

For recreation, too, wildlife is an important resource. BLM proposes to bring 125 million acres of important big game habitat, .5 million acres of waterfowl habitat, 3.5 milion acres of lake and reservoir fishery habitat, and 129,000 miles of fishing streams closer to their highest potential. The increasing demand for hunting and fishing opportunities in the West require intensified habitat development and management.

When properly planned, resource use need not be incompatible with the maintenance of quality wildlife and fish habitat.

These, then, are some of the many aspects of the public lands potential. The resources on these lands, whether economic or social in nature, are more valuable than they were a decade or two ago, and their importance continues to grow. For the "endangered species," including man, their promise for the future is one of continued abundance in needed natural resources, while at the same time they offer escape from the pressures of urban living.

BLM works to protect these resources in other ways, too.

A systematic fire analysis and planning program is conducted on all public lands for which BLM is responsible. Losses are being assessed in terms of damage to the site, acceleration of runoff, impairment of fish and game habitat, and reduction of recreation and scenic values. Upon completion of the program in 1968, each acre will be assessed in terms of social and economic benefits.

The degree of protection necessary to minimize destruction from wildfire in reasonable balance with the land contribution will then be provided.

Engineering Methods Updated

The professional engineering strength of BLM is now centralized at two service center locations, Denver and Portland. The Washington Office provides technical advice and policy guidance on all Bureau engineering functions.

Increased density in population has always caused a disproportionate increase in demand for engineering. Land boundaries become more important, and must be more exact and better defined. The BLM surveys must supply these needs with resurveys, replacement of old corner monuments, restoration of those that have disappeared, and the survey and marking of small tracts.

The Engineering Division has been conducting experiments in coordinating photogrammetry with survey work. The Division now has its first photogrammetric survey unit based both in Alaska and Oregon, using the best of the electronic measuring devices in

Photos by Jim Lee

Public land resources run a vast gamut, from trillions of barrels of oil locked in the Green River formation shale in Colorado, Utah and Wyoming, to the countless hours of enjoyment unlocked by access roads and facilities for outdoor recreation enthusiasts looking for less structured opportunities.

Photo by Woodbridge Williams

combination with the most up-to-date protogrammetric methods to reduce costs and man-hours for a completed survey. Small field electronic computers as well as sophisticated office computers are being used to speed up the work.

Cooperation with other Federal agencies in such fields as geodetic control, aerial photography, and corner search and perpetuation continue to assume more importance. BLM's Engineering Division has also been working to improve communications through upgraded radio systems, to develop and maintain a road system over the public lands, and to establish campgrounds and construct buildings, as well as fences and retention dams.

Another use of the public lands is as rights-of-way for highways, electric power lines, oil and gas pipelines, telegraph lines, electric communication sites, and other facilities.

The impact of these on the public lands has reached a critical point. BLM is working to make the facilities as unobtrusive as possible by careful selection of routes and sites, wise placement, and camouflage. BLM is developing plans for more efficient utilization of existing rights-of-way as one of the important steps toward appearance improvement.

During 1967, Job Corps Conservation Centers operated by BLM in conjunction with the Office of Economic Opportunity continued to offer a program of basic education and work experience to underprivileged youths.

The BLM Job Corps centers are at Tillamook and Grants Pass, Ore.; Kingman, Ariz.; Mountain Home, Idaho; and Price, Utah.

During the year Job Corpsmen constructed recreation areas, dams, fences, and roads, collected seed cones, and fought forest fires. They assisted local communities in civic projects such as dismantling an old building in Cave Junction, Ore., to make way for a new building.

International Cooperation Stressed

The Bureau has provided continuing professional consultation to nearly 70 developing nations on their land and resource management programs, mainly through agencies of the Department of State and international organizations.

Through the Agency for International Development, the Bureau is providing primary assistance to the Ministry of Animal and Forest Resources of the Northern Region of Nigeria on a resource management program of five demonstration projects totaling over one million acres. Conservation improvements, controlled grazing, better meat and milk production, and improved health facilities and education are some of the objectives.

The Nigerian program started with range management and is being extended to a comprehensive multiple-use program that eventually will include the whole region, an area about the size of Texas.

The Bureau developed the program for a two-year resource management course for a school at Kaduna, capital of the Northern Region, and is providing instructions and supplemental on-the-job training in the demonstration areas and BLM districts in the United States. Training in American universities is part of the program. A full resource management degree course at a Nigerian University is being considered to train Nigerian personnel.

The Bureau also is working with the recently established Brazilian Land Reform Institute in formulating their programs, establishing method systems for handling land distribution and management activities, and setting up organized area programs. This assistance consists of technicians working through the American Institute of Free Labor Development on Northeast projects and directly with the Land Reform Institute.

Approximately 70 officials of other countries observed BLM practices or worked in BLM offices during the year.

FISH AND WILDLIFE RESOURCES

2

Standard Oil Company (New Jersey)—"The Lamp" Magazine—Photo by Thomas E. Mahnken

MAN . . . an endangered species?

> *"We have misused our land and allowed our wastes to pollute and destroy our air and waters. Mankind must change its ways or accept the very real prospect of extinction."*
>
> Congressman John D. Dingell
> Michigan

Bureau of Sport Fisheries and Wildlife

Well-being includes being well fed. Accordingly, man's food supplies, in the face of a rapidly growing human population, must be protected from any loss. But sometimes this need to protect our food comes into direct conflict with certain species of wildlife. Better methods of reducing agricultural damage by wild animals without losing their overall value to the human environment are constantly being developed by the Bureau of Sport Fisheries and Wildlife (BSFW).

Also, while increasing food production, we must safeguard man himself from his own use of those chemicals which make most of our agricultural efforts so successful. Interior's responsibility in determining dangers from widespread use of pesticides is carried out by BSFW through a nationwide pesticides surveillance and monitoring program.

In assuring food and fiber, we must guard against more subtle, but equally important dangers to man's total well-being—not only physically, but mentally, socially, and spiritually. Two of the gravest dangers facing man may be the threat to him as a creative individual, and the threat to him as an inseparable part and product of that environment. There is increasing concern about conformity, automation, and the corporate loss of the individual—concern about our population centers, the use of leisure time, and how man can adapt to these changes without losing his identity and purpose as an individual.

Our goal is for people to become more affluent, more mobile, and to have more leisure than ever before. They will expect and need a higher quality environment. Yet the total relationship between man's health, well-being, and his environment is not fully understood. Modern technology has outpaced understanding and wisdom in maintaining high environmental standards.

Degradation of environment is a gradual process; unfortunately, it has been accelerating rapidly. The stench and ugliness of pollution are apparent in too many waters which, only a few years ago, supported thriving populations of fish and wildfowl. Habitat for wild creatures is being engulfed by urban sprawl. The quality of our landscape is deteriorating, as the need for recreation grows.

One important step in creating a healthy urban environment and one that must precede any hope for natural beauty in the slums and ghettos, is to remove urban rats—a major symptom and major cause of deteriorating social conditions. Rats, garbage, poor housing, illiteracy, low income, and other problems collectively present a social situation that needs urgent treatment. Ironically, we have the capability to control rats. The difficulty lies in applying this knowledge effectively through existing channels of federal, state, and local units of government.

Photo by W. M. Spaulding, Jr.

Air, land and water, present in certain ratios and in a reasonably pure natural condition, can provide a teeming wildlife habitat like the one pictured above; the addition of just one inimical factor—in this case, acid mine drainage—can produce the desolation pictured below.

Wildlife is a sensitive indicator of a healthy human environment. It can be likened to the "miner's canary" which warned of oxygen-deficient air. We show concern for the maintenance of all forms of plant and animal life, not as sentimentalists, nor as fishermen and hunters, but because the presence of wildlife in the environment is an indication of the health of that environment. In this sense, the Norway Rat which infests our ghettos is not a species of wildlife, but an undesirable domestic animal completely apart from the normal ecological cycle.

To lose a single species of wildlife means simply that something is wrong To lose a rare and delicate flower, or to lose bluebird habitat is not important because of anguish of the conservationists, but because bluebirds, Indian paintbrush, cardinals, and grizzly bears should be present—because there is something wrong with an environment in which bluebirds cannot live but where rat populations flourish. An environment that threatens these wild creatures is symptomatic of an environment which is going downhill—and taking man with it.

The Department of the Interior and BSFW, along with other federal agencies, have a strong moral responsibility and commitment to maintain this environment. But it is not enough to direct our efforts at existing wald lands, parks, forests, and refuges. We must make certain that wildlife remains an important part of the American scene.

If we believe that "free" animals are indicative of the health of the environment, and if we believe that a healthful environment is essential to mental health, then we must try to develop an appreciation and an understanding of these needs in every citizen.

Our goal is to instill in the minds of men an ecological conscience that will provide public wisdom in judging technological progress. With such a conscience we have the means to produce and sustain a healthy environment in the country, in the cities, in the backyards, along the freeways and in the open spaces; an environment where man's well-being will not be endangered.

Partnership Programs Effective

Many national problems of resource and environment management transcend the authority or capabilities of any one level of government. Federal-state partnerships have evolved as an effective way to cope with such problems. The federal aid in Fish and Wildlife Restoration programs, administered by BSFW, are outstanding examples of federal-state partnership.

Federal excise taxes are collected on certain types of hunting and fishing equipment. This money then is made available to state fish and game agencies to finance three-quarters of the cost of sound projects for wise management of fish and wildlife resources.

Sportsmen, obviously concerned with the outdoor environment, consider this a wise investment. To others who value wild living things as vital components of a healthy and satisfying environment for man, these programs rank high in the larger public interest. As the noted conservationist, Aldo Leopold pointed out, "There is . . . a fundamental unity of purpose and method between bird-lovers and sportsmen."

During Fiscal 1966, Federal Aid apportionments to states totaled $19.2 million for wildlife restoration purposes, and $6.8 million for fish restoration projects. To these were added cooperative programs for anadromous fish and strip-mined land restoration for wildlife.

The Anadromous Fish Program, jointly administered by the Bureau of Sport Fisheries and Wildlife and the Bureau of Commercial Fisheries, was established to assist states in conserving anadromous fish—species such as salmon, steelhead trout, and stripped bass, that ascend freshwater streams from the ocean to spawn.

Fishes of the Great Lakes that move to tributary streams are also included under the Anadromous Fish Program.

Although only in its first year, more than $1 million in federal funds, matched by at least an equal amount of state funds, have been provided to 25 coastal and Great Lakes States for 35 different projects. These projects include research, spawning area restoration, supplements to natural reproduction, and establishment of high-value sport fish in the Great Lakes.

River-Wide Projects Undertaken

With BSFW guidance and assistance, multi-state programs for cooperative projects are being developed for larger rivers, beginning with the Connecticut and the Delaware. Through its regional offices, BSFW assists such regional cooperation, and helps develop projects which improve fish and wildlife conditions by solving environmental problems that extend beyond borders of any one state.

Nowhere is the human significance of land and water more apparent than in the Bureau's responsibilities for water resource development projects. Such projects are being proposed at the rate of more than 1,000 per year, and will affect citizens of this country for generations to come.

Each of these water projects has as its objective some obvious good for man. In each project, however, the rearrangement of the land and water base will result in some not-so-obvious losses. Some of these losses may be permanent and irreversible.

Viewed in this light, recommendations for preserving or enhancing fish and wildlife resources at flood control, irrigation, power, or small watershed projects serve others than hunters and fishermen. During the past year, Bureau biologists and administrators have objected to still another land fill in a Florida estuary, spoken against a huge reservoir that would permanently drown the Yukon flats of Alaska, and publicly criticized indiscriminate draining of potholes in the Dakota prairies. The Bureau supports such concepts as the preservation of a few of the nation's remaining wild rivers, a remnant of wilderness, and especially the establishment of a national program to preserve estuaries.

All living things, including man, are meshed in an inter-dependent web of life. Even the most subtle change may have far-reaching effects. Every bite of the dragline alters this environment for better or for worse. Time and again biologists, ecologists, and other scientists have urged caution in connection with land and water resource development to insure that changes are for the better.

Others are beginning to share this view. On June 5, 1967, the United States Supreme Court stated in a decision involving High Mountain Sheep Project on the Snake River, Idaho-Oregon:

"The importance of salmon and steelhead in our outdoor life as well as in commerce is so important that there certainly comes a time when their destruction might necessitate a halt in so-called 'improvement' or 'development' of waterways."

Appreciation of Wildlife Importance Grows

Because fish and wildlife and man are inseparable from land and water, we must plan projects to conserve and improve wildlife-related values while maintaining and improving the quality of man's environment. As the population increases and water and land development intensifies, problems become increasingly complex. The heightened awareness of policy makers and the public in meeting this challenge indicates that, as a nation, we are learning to live in greater harmony with our natural environment.

Our earlier dependence of "game" for survival has gradually changed to a broader appreciation of wildlife. Unfortunately, nearly 40 species of birds and mammals were lost to the United States within the past 150 years—half of them since 1900. Another 78, including reptiles, fish, and amphibians, are on the present endangered list.

National Wildlife Refuges, to preserve these endangered species and others more numerous, had their beginning in 1903 when President Theodore Roosevelt established the tiny Pelican Island Refuge in Florida. The National Wildlife Refuge System is now the largest in the world. It reflects concern for protection of wildlife habitat and management of valuable, irreplaceable natural resources.

There are 317 units in the System totaling about 28.5 million acres. The National Wildlife Refuge System also includes over 500,000 acres in Waterfowl Production Areas, and small but excellent duck-producing wetlands in the prairies of North Dakota, South Dakota, Minnesota and Nebraska.

During the past year, seven refuges were added to the System, for development principally as migratory waterfowl areas. These include Brazoria Refuge near Freeport, Texas; Coastal Maine Refuge, between Portland, Maine, and Portsmouth, New Hampshire; Flint Hills Refuge, on the Neosho River between Emporia and Burlington in western Kansas; Las Vegas and Maxwell Refuges in northeastern New Mexico; Muscatatuck Refuge along the Muscatatuck River in southeastern Indiana; and Ridgefield Refuge in southwestern Washington.

A new National Wildlife Refuge is never acquired in final operating form. Shallow, freshwater pools, when properly developed, provide duck and goose food that requires no cultivation—the birds do the harvesting. Application of new techniques on the nearly 250 waterfowl refuges, most of which are only partially completed, has produced outstanding results.

Studies were completed on 28 refuge areas proposed for wilderness status. Public hearings generally supported these wilderness proposals.

Added protection would be afforded bird nesting rocks, heron colonies, and areas of unique habitat such as found in Okefenokee National Wildlife Refuge, Georgia.

During the early exploration of America, wildlife resources seemed unlimited. The idea of reducing the 60 million buffaloes then roaming the Great Plains to a few scattered herds numbering less than 300 animals by 1900 would have seemed ridiculous. Today the buffalo population has climbed back to several times this number, and is protected on refuges.

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Rare baby—a whooping crane.

Trumpeter swans, never abundant, reached their lowest population level in 1935 when 73 swans remained, 46 of them on the Red Rock Lakes National Wildlife Refuge, Montana. This, the largest of all North American waterfowl, has now increased tenfold, with surplus birds transplanted to other suitable refuges in Wyoming, Oregon, Washington, and South Dakota.

The whooping crane became nearly extinct in 1952; only 21 birds remained. Greater attention has been accorded this bird's survival than any other species. In the fall of 1966 the entire population of 43 birds returned to the Aransas National Wildlife Refuge on the coast of Texas from their Canadian nesting ground. In 1967, United States and Canadian wildlife experts cooperated in a successful program of hatching whooping crane eggs taken from the wild nest.

Fifty years have passed since birds were given international recognition as a resource deserving greater protection.

A convention between the United States and Canada for protecting migratory birds was ratified in 1916; a convention with Mexico was ratified in 1936. The Migratory Bird Treaty Act implementing these treaties, and an active program of surveys and enforcement carried out by the Bureau, have safeguarded many species. As a result, migratory bird hunting is still a major form of outdoor recreation for millions of Americans.

Dedicated game management agents and biologists enforce federal migratory bird laws and make bird population and habitat surveys annually. They also carry out banding operations in the United States, Canada, and Mexico as part of the continuing wildlife fact-gathering process. This continent-wide information-gathering and enforcement task is a cooperative effort of state law enforcement officers, biologists and other personnel from Provincial, Canadian, and Mexican governments.

Job Corpsmen Tackle Conservation Tasks

In the Bureau's seven Job Corps Conservation Centers, more than 1,000 disadvantaged youths from all parts of the country, ranging in age from 16 to 21, are being trained as better citizens through needed conservation and outdoor recreation work. Educational deficiencies of Corpsmen are being remedied by academic programs in which each corpsman can progress at his fastest possible rate. Work skills training leading to gainful employment is provided in land management practices, heavy equipment operation, small tool operation (both power and hand types), surveying, welding, elementary forestry, wildlife practices, and fire prevention and control.

Since training is performed on actual refuge projects, the refuge program has benefitted markedly. Accomplishments include construction of ponds, fences, access roads and nature trails, bridges, dikes, development of picnic sites on public use areas, timber stand improvement, and building of signs, traps for banding birds and animals, and artificial nests for waterfowl.

These are young men developing themselves as they develop their country's natural resources—learning conservation as they learn to work. The final product is a good conservationist *and* a productive citizen.

Sport Fishing One of Top Outdoor Pastimes

One of the most popular types of outdoor recreation is sport fishing, enjoyed by more than 28 million Americans. Only by maintaining the nation's aquatic habitats in a high state of productivity, free of abuse, can present and future demands on the sport fish resource be met. Conservation efforts aimed at waters on federal lands and Indian reservations, complement and supplement those of state fishery agencies. Guidance on fishery management problems is provided to other federal agencies responsible for administering public lands and to Indian tribes. Such federal and Indian lands make up 36 percent of the nation's land and water areas and embrace some of the highest quality sport fishery habitat in the United States. Fish are a good barometer of water quality. Water that supports a healthy population of desirable fishes has the quality to meet requirements of most other water uses.

In fiscal 1967, the Bureau assisted in sport fishery management on 314 federal areas and Indian reservations. A total of 711,729 acres of lakes and ponds and 8,509 miles of streams was included in management projects that provided 5.3 million man-days of fishing. Federal-state cooperative projects covered an additional 305,018 acres of lakes and ponds and 1,350 miles of streams which provided 3.2 million man-days of fishing.

In 1960, Congress gave the Bureau authority for the Cooperative Fishery Unit Program. The 23 units, operated in partnership with state conservation agencies and colleges and universities throughout the country, provide a ready pool of fully trained fishery biologists to meet federal, state, and private needs, conduct research that will help in managing the nation's fishery resources, contribute to public knowledge of fishery resources management, and participate in national surveys, fishery resource inventories, and other projects requiring a high level of professional competence. Many research projects by unit employees and student assistants are aimed at a healthful aquatic environment throughout the Nation.

Chemicals and Mining Create Problems

The effect of chemical pesticides on our society has become one of the most controversial subjects in the nation's history. Evidence that promiscuous use of pesticides results in immediate and long-range effects on aquatic resources continues to mount. In 1967, the Bureau's fishery biologists started a nationwide program to monitor pesticides in fish.

Samples will be taken twice each year at 50 stations. This is but one phase in a national monitoring program to determine residue levels in man, air, water, soil, and wildlife.

Information compiled by state and Bureau biologists indicates that nearly 13,000 miles of streams totaling about 135,000 surface acres, 287 natural lakes of 104,000 surface acres, and 228 impoundments totaling nearly 27,000 surface acres have been moderately to severely affected by surface mining activities. In addition, 1.7 million acres of land have been similarly damaged for wildlife purposes. Bureau biologists provide technical assistance to federal and state agencies, and to private industry in reclaiming mining areas to productive fish and wildlife habitat. The bureau also is continuing to locate replacement habitats for rare and endangered fishes, and to look for ways to preserve them.

Man's place on the planet is basically similar to that of other forms of life. Like them, he is dependent on the quality of his environment for the maintenance of his species. Opposing forces—the need for increased sport fishing versus the decreasing quality of sport fish habitat—are responsible for the urgent need for knowledge that can make the fishery resource managers' task more efficient and more effective. This knowledge is the objective of the Bureau's fishery research programs.

Artificial reefs hold promise in managing salt water sport fish. They also can help dispose of waste materials now littering the country. An intensive study to test materials, water depth, and fish attraction potential is underway.

A chemical method for eradicating certain unwanted fish has been developed through BSFW research. The chemical is virtually non-toxic to fish organisms, leaves no longlasting residues, and does not alarm target fish to avoid treated areas. The process is particularly useful for controlling unwanted fish in catfish ponds without harm to catfish.

Fish Farming Importance Grows

Research at the Bureau's Fish Farming Experiment Station is making a major contribution toward increased production of food for a growing population. Fish farming is now so well established in the lower Mississippi River Valley that it is regarded as a basic part of the local agriculture. Research is advancing on spawning, care, and rearing of fry and fingerlings, disease control, supplement feeds, feeding methods, stocking methods and water management.

The fishing habits and recreational pursuits of a substantial portion of our population have been altered by the numerous reservoirs constructed in recent years. Today, federal reservoirs provide approximately 30 percent of the fresh water acreage available for public fishing. To solve problems of establishing a productive fishery in these impoundments, Bureau scientists have undertaken long-range studies involving physical, chemical and biological factors and their interrelations to determine how water management affects fish production.

Federal leadership in the area of fish culture continues to point the way toward more efficient operation and better product—steps toward better fishing for an outdoor-minded America.

Production of fish at approximately 100 National Fish Hatcheries has increased to meet the country's needs. Studies by management biologists, both state and federal, define biological needs. Species of fish, size of fish, and time of planting are of prime importance in fisheries management. These and other factors dictate the scope and direction of hatchery operations geared to meet specific goals.

A survey to determine needs for hatchery produced fish was carried out last year in cooperation with state conservation agencies and commercial fish producers. This nation-wide survey will determine current needs for hatchery fish, and also project requirements for the years 1973, 1980, and 2000. Fishermen of tomorrow can continue to experience high-quality fishing in most areas. Despite population growth, increasing urbanization, and great changes in land and water use, modern fish management concepts will continue to pay dividends.

The Bureau, aware that population pressures and other factors are threats to wildlife resources, directed its research efforts in 1967 toward developing new or improved techniques to offset these dangers. Eight species of rare and endangered birds, or close relatives, are now under propagation at the Patuxent Wildlife Research Center. Included are whooping cranes, sandhill cranes (3 races), Aleutian Canada geese, white-fronted geese, Hawaiian geese, South American snail kites, Andean condors, and southern bald eagles.

Life history field studies are also being conducted on black-footed ferret, Everglades snail kite, California condor, masked bobwhite quail, and various rare and endangered wildlife in Hawaii.

Breeding Bird Survey Expanded

A breeding bird survey, designed to measure changes in the abundance of nesting birds, was expanded to encompass states east of the Mississippi River and 4 eastern Canadian Provinces. Volunteer professional and amateur orinthologists assisted. Information obtained for over half a million breeding birds of approximately 260 species was transferred to machine punch cards for analysis.

A comparison of 2 years' data for Maryland showed significant decreases in eastern meadowlark and eastern bluebirds, and significant increases in bobwhite and downy woodpeckers. Populations of other species were essentially unchanged from 1965. The next survey will be expanded to cover the first 11 states west of the Mississippi River and 2 additional Canadian provinces.

Three experimental waterfowl seasons were monitored in the past year, all designed to increase hunter recreation without depleting the resource. The most extensive was a September season on teal for 20 States in the Central and Mississippi Flyways, the second year of a 3-year experiment. The experimental season provided more than 200,000 man-days of recreation in one year without adversely affecting the continental population of any waterfowl species.

An experimental hunt started in 1963, was repeated the past year in San Luis Valley, Colorado, to evaluate the impact of shooting on a well delineated mallard population. At the end of the fourth year, findings indicated the population has remained fairly stable.

An experimental black duck season in New England was begun in 1966 on the theory that blacks, wintering there, might provide more recreation without jeopardizing breeding stock. A special season, approved on a permit basis, allowed a daily bag and possession limit of 4 and 8 birds. It added 24 days of waterfowl hunting in Maine, New Hampshire, and Massachusetts. The bag per successful hunter averaged 5.6 birds.

Man's intelligence has allowed him to rise far above other animals, but he remains subject to many of the same influences that endanger wildlife. All good wildlife biologists know that habitat, not hunting, is the real threat to an animals' continued existence. Humans worry about "the bomb" and other physical violence, but in the long run, the limiting factor for man will also be his "habitat"—the environment he has so carelessly abused.

Bureau of Commercial Fisheries

One of the major specters threatening man today is failure to provide an adequate protein diet for the earth's nearly 3 billion inhabitants. This unevenly fed population is expected to double before the year 2000, more than doubling our planetary food dilemma. It is against this setting that the Bureau of Commercial Fisheries (BCF) is carrying out its mission.

The oceans may help solve man's nutrition problem, but the world's aquatic resources themselves are endangered by the activities of man. Pollution has become a serious problem as man advances his technological skills. Disasters similar to the breakup of the oil tanker Torrey Canyon off Britain in March 1967 remain a threat to our shores. Improvements in fishing gear and methods of catch can jeopardize individual fish species as the fishermen of many nations compete. Man will face grave consequences if he does not manage his fisheries wisely.

Yet there is great potential in the oceans. Some scientists believe that the present annual world catch of 52 million metric tons is as little as 10 percent of the potential allowable catch.

Many of BCF's programs are directly related to this problem of maintaining and increasing the food potential of the sea. BCF's exploratory fishing activities help discover new resources. Fishery scientists work for maintenance of high productivity levels and look for ways to use the bounty of the sea.

FPC—A Major Milestone

A major milestone was reached February 2, 1967, when the Food and Drug Administration approved the Bureau's process for manufacturing fish protein concentrate (FPC). This opportunity for using resources previously not economically harvestable has been termed by Secretary Udall "a lifeline to the future for the world's hungry millions."

Now the Bureau hopes to prove that FPC can be manufactured commercially at a reasonable profit. BCF aims to have the government's first pilot FPC plant in the Pacific Northwest ready in 1968. It will be capable of processing 100,000 pounds of raw fish in 24 hours to produce 16,000 pounds of FPC. The Bureau's small experimental plant at Beltsville, Md., could produce only 100 pounds of concentrate in a 24-hour period in processing 600 pounds of fish.

If ambitions for the product are to be fulfilled, FPC must attract private investment. The first plant will examine the feasibility of manufacturing FPC by the Bureau's process and provide a basis for design and construction of full-scale plants by private concerns.

FPC is manufactured from ground up whole fish, currently Atlantic hake. Because it contains over 80 percent animal protein, FPC can overcome protein deficiencies in vegetable diets when used as a food additive. The product has been successfully tested as an ingredient in beverages, noodles, gravy, bread and cookies. Naturally, the addition of the concentrate to such products materially increases their nutritive value.

The potential of FPC has been underscored in studies by the United Nations' Food and Agriculture Organization and World Health Organization, which have described protein deficiency as the most pressing problem of the century.

By some estimates, over 80 percent of the world's population does not receive sufficient daily protein, while 60 percent verges on actual protein starvation. Progress to relieve this condition has largely been offset by the accelerating rate of population growth in some areas.

President Johnson has urged that development of the concentrate "proceed on an urgent basis." He referred to FPC at the Latin American summit conference in Punta del Este, Uruguay, April 14, 1967, when he said:

"We are also prepared to set up in Latin America a demonstration center in the field of fish protein concentrates. We believe that this essential ingredient of a balanced diet can be provided at a much lower cost than has ever been known in our history."

"It seems certain," Secretary Udall has said, "that fish protein concentrate plants eventually will be built on the shores of many nations, as the United States once again shares its scientific and industrial progress with the developing nations of the world."

FDA approval therefore presented BCF with the opportunity to assist in alleviating world hunger problems, to stimulate its fishing industry and to improve nutrition at home.

Environmental Menaces Fought

Even as FPC bids to become an exciting prospect for the future, other Bureau programs to improve man's environment are attaining dramatic results.

On the Great Lakes, the Bureau is cooperating with Canada and surrounding states in fighting the sea lamprey menace. The lamprey is an eel-like predator which

Standard Oil Company of California—"Bulletin" Magazine—Photos by Jon Brenneis

Commercial fishing, a keystone of Alaska's economy, had a 1966 wholesale value of more than $160 million. Most valuable products are salmon, King crab, shrimp, herring, halibut, Dungeness crab, and salmon roe.

kills its victim with its circular mouth, rasping tongue, and piercing teeth.

Primarily by the use of a lampricide, a chemical substance harmful only to sea lampreys and developed by BCF scientists at Hammond Bay, Mich., the lamprey population in Lake Superior has been reduced by more than 90 percent since 1961. As a result, lake trout fishing is considered twice as good as it was five years ago.

Before the lamprey predation started, commercial fishing on Lakes Superior, Michigan, and Huron realized $7.5 million annually.

Man himself created the need for these intense lamprey control efforts by building the Welland Canal around Niagara Falls in 1829. This canal permitted the sea lamprey to migrate into the upper Great Lakes from Lake Ontario, their natural habitat for thousands of years.

It took almost a hundred years for the lampreys to traverse Welland Canal and Lake Erie and enter the more suitable waters of Lake Huron in 1932. They were discovered in Lake Michigan in 1936 and Lake Superior in 1945.

Lake trout bore the brunt of the predatory attacks. Catches went down first in Huron, then in Michigan, and finally in Lake Superior.

The lamprey is non-parasitic in its larval stage, which lasts from four to seven years, after which the creature moves from tributary streams into the lakes to become a predator. Each lamprey, which attains a length of 12 to 24 inches and a weight of about 4 to 6 ounces, is estimated to destroy at least 20 pounds of fish in the 1 to 1½ years of its parasitic stage. The lamprey lives only about two months beyond the parasitic period, during which time it spawns and dies.

Although the lamprey is found in many parts of the world, the Great Lakes invasion marks the first time it has been known to disrupt an established fishery.

Efforts to find commercial uses for the lampreys have been unsuccessful. They are unacceptable to Americans as food, although they are eaten in many European countries. Analyses indicate that oil yield and Vitamin-A potential are much too low for commercial exploitation.

Alewives Add to Lake's Problems

The sea lamprey, however, is not the only danger on the Great Lakes. The Welland Canal also provided a route for alewives, an unwelcome fish species which underwent a population explosion in the early 1960's that helped upset the ecological balance in Lake Michigan. Their abundance clogs city water intakes during spring spawning runs and clutters beaches and harbors during frequent massive mortalities of the species.

BCF is studying alewives—learning more about their diet, distribution, behavior and ecology—in efforts to develop improved control methods. Bureau scientists believe the alewife population is reaching a peak in Lake Michigan and a decline is probable, although the alewife will remain the most populous species for a number of years, and the troublesome die-offs may continue.

BCF scientists at Oxford, Md., in cooperation with states and universities, made significant new findings in the past year in their studies of the destructive oyster parasite "MSX" by identifying additional life history stages which may help scientists develop control methods.

During the past decade the MSX blight virtually wiped out the oyster industry in Delaware Bay, and has caused severe economic hardship in the lower Chesapeake Bay.

Federal money under the Commercial Fisheries Research and Development Act of 1964 was allocated during the year to Virginia, Maryland, New Jersey, and Delaware to help those states develop disease-resistant strains of oysters and rebuild valuable oyster beds.

Efforts to wipe out MSX, the sea lamprey, and other menaces will be useless, however, unless the overriding problem of pollution can be abated. Pollution has become serious in the Great Lakes, especially Lake Erie, and in many other inland waters. In the past decade it has become clear that pollution also can seriously damage the edges of the sea.

Estuaries Hold Fisheries' Fate

Nowhere is man's battle to preserve and utilize his environment more important, however, than in the nation's estuaries, the places where the fresh water of streams meets the salt water of the sea.

Many estuaries have been severely damaged by the activities of man—dredging, filling, polluting. About 65 percent of the United States commercial fishery harvest consists of species which spend all or part of their life cycles in estuaries. They must do so or perish. Most marine sportfish species are similarly dependent on estuarine areas. Man-made changes in these estuaries can have far-reaching effects on species that support valuable commercial and sport fishing.

Obviously, man must consider the effects of his growing technology upon his natural resources. Rising encroachment on vital estuaries is an urgent case in point. BCF and the Bureau of Sport Fisheries and Wildlife are struggling to conserve these estuaries and control their uses in a manner that recognizes the need for conservation along with economic development.

While no figures have been compiled on the total estuarine water and land area destroyed or made unfit by pollution, nor of the economic loss incurred, the losses are substantial. For example, each year public health officials condemn more shellfish water than they reopen. Periodic mass fish kills in rivers and coastal waters often come from natural causes, but it also has been proven that some serious kills have been caused by pollution.

Aside from pollution, filling and dredging of estuarine areas take a heavy toll of habitat. At last count, more than 7 percent of the nation's prime estuarine space is estimated to have been lost to these actions. Heaviest loss by far—67 percent—was in California.

BCF is studying the effects of estuarine changes on fish and shellfish. Research on the effects of pesticides in estuaries is underway at the Bureau's laboratory at Gulf Breeze, Fla.; research on the effects of radioactive materials on estuarine species is being done with the cooperation of the Atomic Energy Commission at the radiobiological laboratory in Beaufort, N.C.

Pesticides, which have become a part of the marine and coastal environment, are of particular concern to the fishing industry. Some of the most valuable species of fish and shellfish are also the most sensitive to pesticides. Ten marine animal groups make up 80 percent of the economic value of the United States fishery. Of these, 5 (shrimp, mollusks, Pacific salmon, crabs, menhaden) spend important parts of their lives in estuarine waters and are vulnerable to pesticides and other pollutants.

In the laboratory, Bureau scientists have learned that high residues of pesticides in fish can impair or prevent reproduction, slow down the growth rates, and weaken resistance to natural environmental stresses. Such knowledge is used to decide which pesticides are safe to use and how damage to aquatic life can be prevented.

Water Warm-Up Effects Studied

Nuclear and fossil fuel power plants can cause temperature changes in estuarine waters and may increase the normal death rate of fish as much as three times.

In the next few years, predicted demands for power in the Pacific Northwest will require construction of several nuclear-powered and coal-powered electric plants. Under certain conditions these plants could add heat to streams already dangerously warm for salmon and trout in summer. Such problems in the Columbia River region of the Northwest are being studied by BCF in cooperation with the Bureau of Sport Fisheries and Wildlife and other federal agencies, with fishery agencies of Oregon, Washington, and Idaho, and with faculties of universities.

Columbia River salmon and trout are of prime importance to the area's economy. Bureau surveys have shown that farming, logging, and mining also severely injure salmon and trout populations, and dams often form impassable barriers.

Through the federally financed cooperative Columbia River Fishery Development Program, streams have been improved, fishways have been built to bypass dams, and natural and man-made obstacles to the migration of salmon and steelhead have been removed. In addition, hatcheries have been built, minor falls have been improved, and screening facilities have been provided to prevent young salmon from being swept into irrigation channels.

The Bureau conducts intensive research on salmon and trout passage at high dams and seeks to resolve problems of anadromous fish—those that return to fresh water to spawn.

The nation's concern with safeguarding anadromous fish was further emphasized in 1965 by passage of the Anadromous Fish Act administered jointly by BCF and the Bureau of Sport Fisheries and Wildlife. This legislation provides $25 million through June 30, 1970, with federal funds financing up to 50 percent of the cost of approved projects submitted by the states.

Locating New Resources

The Bureau's work in locating new resources is related to the overall goal of providing ample opportunity for domestic fishermen. The United States requires continuous access to an adequate and dependable supply of fish and shellfish products to provide for an increasing population and a continually improving standard of living. BCF marine laboratories devote much research to insuring an adequate supply of raw material for FPC and other food products.

The Exploratory Fishing and Gear Research Base at Seattle made the commercial exploitation of hake off the West Coast possible by devising a mid-water trawl that greatly increased the possible catch. The government's first FPC plant will be located on the West Coast because unused stocks of hake are available there, and because Food and Drug Administration regulations restrict manufacture of FPC to hake or hake-like species at this time.

BCF vessels located a new calico scallop resource off the Atlantic Coast in 1959. Production in North Carolina has increased significantly since then. In 1959, 3 boats produced 6,500 pounds of meats valued at $2,600 to fishermen. In 1966, 17 boats produced 1,856,700 pounds of meat valued at $451,562.

Bureau scientists and their colleagues on the Inter-American Tropical Tuna Commission are developing methods to predict the wide variations in tuna abundance in the eastern Pacific fishery and to learn how to harvest large skipjack tuna resources to the westward.

Natural Fluctuations in Abundance

Many fish species exhibit natural fluctuations in abundance which often are confused with effects produced by man. These natural fluctuations create enormous difficulties for fishermen and complicate the scientific management of our coastal resources.

BCF is constantly looking for alternative resources so that the fishing industry need not rely upon a single fluctuating species. For example, BCF is learning how to locate and catch other abundant herring-like species in the Gulf of Mexico as an aid to the menhaden industry.

At the Fishery-Oceanography Center, La Jolla, Calif., the Bureau raised Pacific mackerel and sardines from the egg to an "advanced juvenile stage" for the first time by man, to gather information needed in the conservation and management of the species. At Honolulu, BCF researchers are measuring the vision and hearing acuity of tunas as they plot new ways to catch this popular food fish.

The Bureau, in the course of its fish farming research on marine species, has developed methods for artificial production of seed oysters at BCF's Milford, Conn., laboratory. These methods have been adopted by industry.

Modern fish culture methods are called aquiculture. Use of this body of knowledge in production of seafood will provide sources of food for our expanding population, variety for our diet, and nutrients for our health.

International Cooperation Valuable

To preserve valuable fish species, international arrangements are necessary. The United States is a member of eight international commissions that recommend conservation measures for marine and fresh water fisheries.

Following passage of legislation which extended the United States fisheries jurisdiction from 3 to 12 miles from shore in October 1966, Bureau officials participated in negotiations with representatives of the Soviet Union and Japan to discuss their claims to traditional fisheries off the United States.

Agreements were reached with the Soviet Union in February 1967 and with Japan in May 1967. In general, these agreements permit certain operations by these countries within the 12-mile zone in return for limitations upon some activities beyond the zone. The accords will insure continued access to resources for United States fishermen, and reduce gear conflicts.

Amelioration of international fishery problems is just one way in which BCF assists the United States industry. In its services to the fishing industry, the Bureau collects information on foreign fishing activities and provides market news reporting of current domestic and foreign market information on fishery commodities. It conducts statistical and economic surveys on producing, processing, distributing, and marketing of fishery products and promotes consumption of fish through a variety of marketing programs, including participation in international trade fairs. The Bureau also aids industry through financial assistance programs.

The Bureau's concern for human welfare took on an even more direct aspect when the President, on November 2, 1966, signed the Fur Seal Act—a conservation act that benefits human beings more directly than it does seals.

It applies to a remote cluster of windy and foggy islands in the Bering Sea off the coast of Alaska, five of which constitute the Pribilof group. Two of these, St. Paul and St. George, are home to 650 Americans.

It is the Pribilovian Aleuts who accomplish the annual seal harvest, and under the sound management practices agreed upon by diplomatic negotiations among the United States, Japan, Canada, and the Soviet Union, an annual average yield of 60,000 sealskins is sustained.

The fur seal count has rebounded to an estimated 1.5 million animals today from a level of 200,000 in 1911. Catches are carefully regulated on the basis of factors affecting the seal populations.

Intent of the Fur Seal Act is to provide for these people the same rights to real property ownership and local self-government and the same opportunity to exercise responsibilities of citizenship as other U.S. citizens.

The new law recognizes earlier services of the Aleuts in the Government-operated fur seal industry so they can enjoy more meaningful Civil Service retirement benefits. Townsite boundaries have been agreed upon and a land survey is being accomplished. Government-owned homes will be appraised and made available for purchase by the Aleut residents. The community also is taking over exclusive management of business enterprises formerly administered by the Federal Government.

Transitional grants authorized by the 1966 Act will assist the Aleuts in establishing their own local government on a sound basis. The law opens a new era of opportunity for the Pribilof Aleuts.

Ultimately, the Bureau's efforts to harvest and maintain the riches of the oceans will benefit not only domestic fishermen, but also all mankind. Man has much to gain by preserving the world's fishing resources.

As naturalist Edwin Way Teale wrote in *Wandering Through Winter:* "It is those who have compassion for all life who will best safeguard the life of man. Those who become aroused only when man is endangered become aroused too late. We cannot make the world uninhabitable for other forms of life and have it habitable for ourselves. It is the conservationist who is concerned with the welfare of all the land and life of the country who, in the end, will do most to maintain the world as a fit place for human existence."

WATER RESOURCES 3

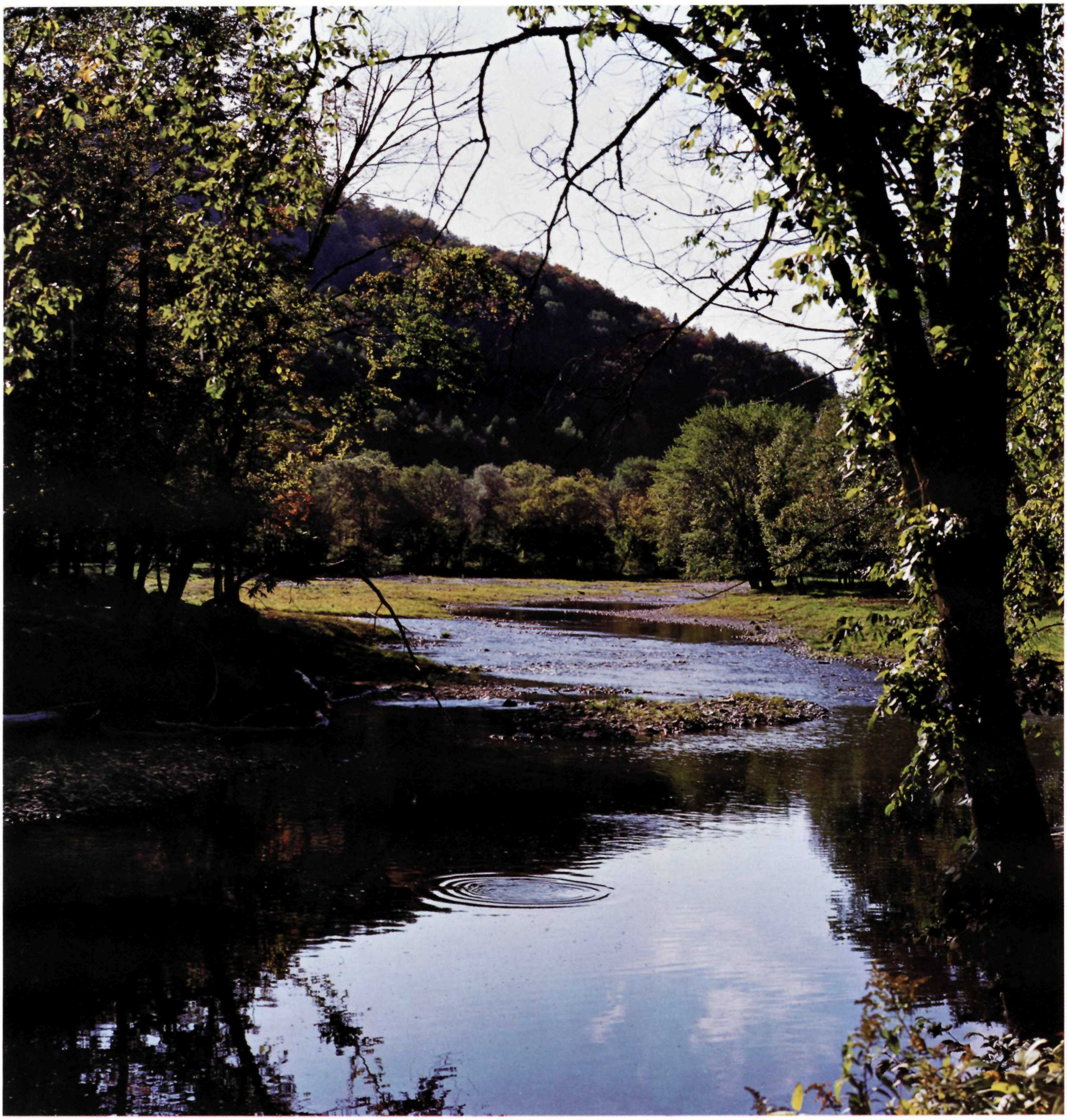
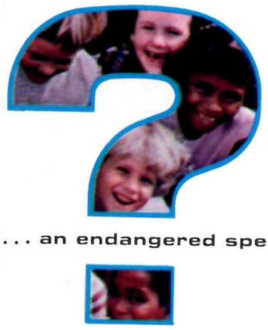


Photo by Carlos Elmer



MAN . . . an endangered species?

"A River is more than an Amenity—it is a Treasure."

—Justice Oliver Wendell Holmes

Bureau of Reclamation

In the rugged, arid West, the 20th Century American has made some wholesome and daring conquests of a once-hostile environment, converting forbidding near-desert terrain into green, hospitable oases which today support a steadily increasing population. Indeed, the West contains some of the fastest-growing population centers of the nation.

It was not always thus.

Centuries ago, possibly about the beginning of the Christian Era, an agricultural haven flowered in the deserts of the Pacific Southwest, near the present-day city of Phoenix. Aboriginal engineers fashioned crude diversion dams, and hand-carved large canals paralleling the Gila River for more than 100 miles. These Indians grew crops and built communities along the Gila and the outlines of their homes and canals have been staked out by modern archeologists. But about the 12th Century, these enterprising Indian farmers disappeared, probably victims of a drought extending for perhaps a half century. These extinct victims of the once-cruel desert climate of the Southwest are known as the Hohokam—the People Who Have Gone.

In modern times, the desert has been a formidable obstacle to travel and habitation. Only the courage of the frontiersmen and the ability of those who followed to find and develop water have made it possible for the expanding nation to develop its interior as well as its hospitable coastlines and humid sections.

There were plenty of cynical critics.

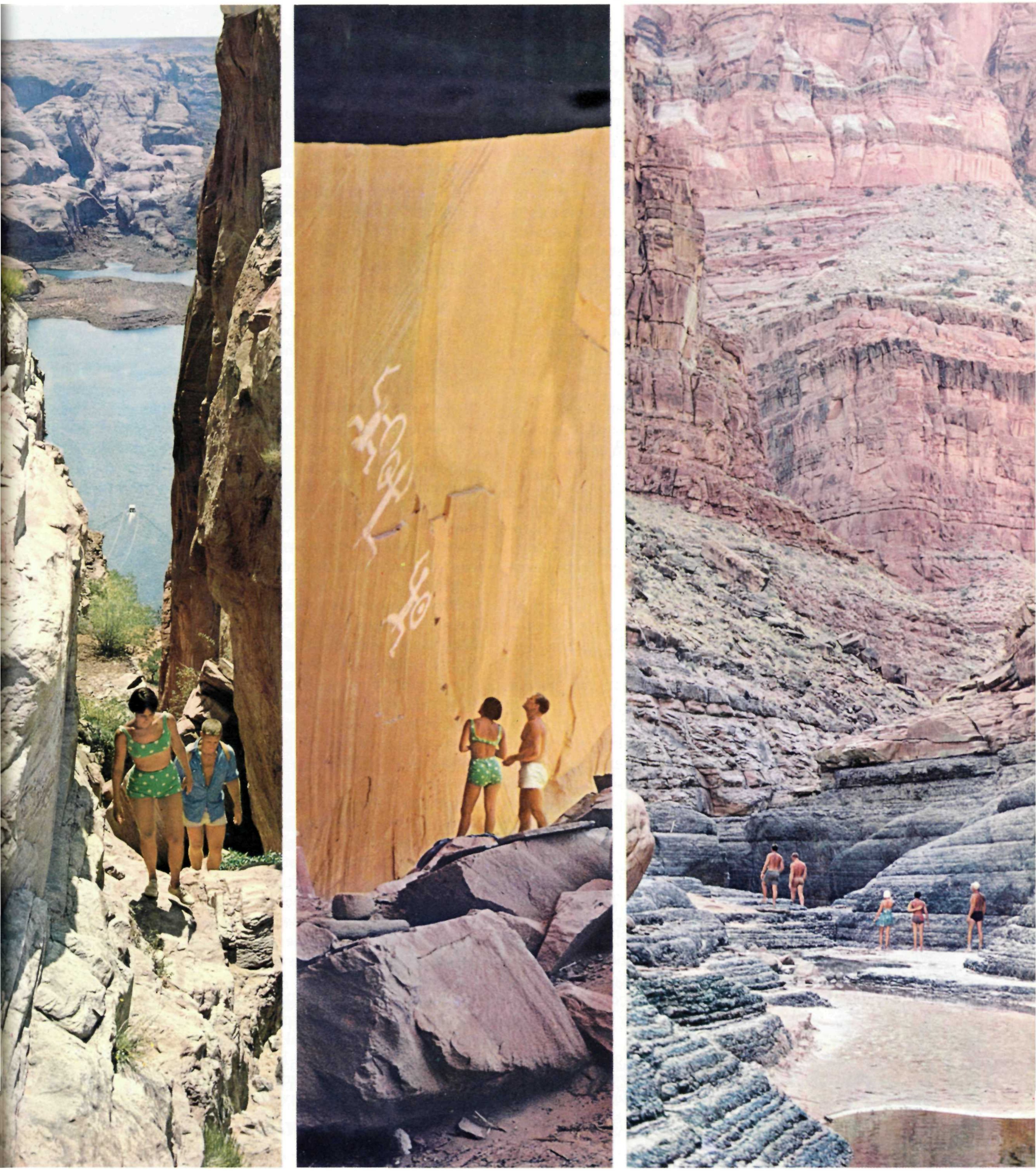
In 1852, the eloquent but shortsighted Daniel Webster, speaking in the Congress against western transportation development, said:

"I will not vote one cent from the Public Treasury to place the Pacific Ocean one inch nearer to Boston than it is. What do we want with this worthless area—this region of savages and wild beasts, of shifting sands and whirlwinds of dust, of cactus and prairie dogs? To what use could we ever hope to put these great deserts and these endless mountain ranges?"

A few years later, the War Department dispatched a young lieutenant on a mission to explore the Colorado River's potential as an avenue of transportation. After days of difficult travel from the river's Gulf of California delta, Lt. J. C. Ives reached the general area of what is today the site of Hoover Dam. He also reached this pessimistic conclusion:

"The region last explored is, of course, altogether valueless. It can be approached only from the south, and after entering it, there is nothing to do but leave. Ours was the first, and doubtless will be the last party

© National Geographic Society—Photos by Walter Meayers Edwards



Using Lake Powell's upper reaches as access, more and more visitors will see such hitherto remote wonders as Hole in the Rock (left), of historic significance to Mormons, pre-Colombian pictographs in Forbidden Canyon (center) and Dark Canyon's ancient sedimentary rock formations (right).

of whites to visit this profitless locality. It seems intended by nature that the Colorado River along the great portion of its lone and majestic way shall be forever unvisited and unmolested."

The disgusted young lieutenant could hardly have missed a forecast by a wider mark. The Pacific Southwest—one of the most arid portions of the nation—tripled in population between 1930 and 1960. And by 1980, the population is expected to nearly double again. The Southwest's rate of growth is 5 percent annually, highest of any major region in the country. The 1,400-mile Colorado River for nearly its entire length is a recreation area, attracting visitors from all parts of the Nation. On only 7/10ths of 1 percent of the nation's cropped acreage, the Southwest alone produced 4.4 percent of the U. S. crop values, including most of the nation's dates, avocados, lemons, and fresh winter vegetables.

The key to this development has been water—the liquid gold from the Colorado River, one of the most intensively used rivers in the world. Whereas most rivers grow in size and volume as they approach the ocean, the Colorado diminishes, and today almost no water reaches the ocean at the river's delta on the Gulf of California. Virtually all its water is put to use in five major drainage basins and in Mexico. Long-term storage permits conservation of water from years of high runoff for use when the annual flow of this erratic stream drops to a third or less of its normal flow. This epitomizes the success—and the challenge—of the West's search for water to make habitable one of the world's modern Edens.

The 65-year-old Bureau of Reclamation has played a major role in the development of the West through making better use of its water. What follows is a highly abbreviated account of the technological crusade carried on by this federal agency to help the people of the Western States achieve a reasonably adequate stable water supply for the greatest population surge in the nation's history.

Trapping Snowmelt for Greenbelts

A characteristic of many streams, particularly those of the west, is their highly variable flow. This is caused principally by spring freshets and floods from the runoff of melting mountain snowpacks, followed by greatly diminished flow during the summer when rainfall is negligible. The annual flow of the Colorado River, for example, has ranged from record flood-year levels of 22 million acre-feet down to as low as 4 million acre-feet.

More than a century ago, when much of the assured flow of western streams had been diverted or earmarked for use, hydrologists had concluded that the economic salvation of the West was the storage of the spring runoff for use during the long, hot, dry summers and beyond. Such resource salvage, even in the early 1900's, required large engineering structures to store the life-giving water, and extensive channels to deliver it to the lands. Such works, too big and complex for private endeavor, had already bankrupted many pioneering water companies when the Federal Government came to the aid of the West with the passage of the 1902 Reclamation Act.

One of the first projects of the fledgling Reclamation Service was construction of a large masonry dam on the Salt River in Arizona. This job required the importation of stone masons from Europe. The resulting Theodore Roosevelt Dam, on its completion in 1911, was hailed as the highest (280 feet) masonry dam in the world. This and succeeding storage structures on the Salt River made possible the development of modern-day Phoenix and the highly productive agricultural valley around it. Hydropower from these dams yielded another necessity for industry which ultimately was drawn to this flourishing agricultural area. The water- and power-users were committed to repay the federal investment, a self-liquidating financing program that was to prove eminently successful.

In two decades, engineers of the Bureau of Reclamation concluded that a mighty concrete dam could be constructed within the precipitous gorge of Black Canyon of the Colorado River. And in another decade during the 1930's the gorge was plugged and the unruly river mastered by Hoover Dam, then the world's highest dam and an inspiring engineering achievement to this day.

The 726-foot-high Hoover Dam is one of the most beneficial structures ever built by man. It removed a flood threat from the Colorado and provided an assured supply of water to three of the world's great agricultural spots, producing crops in the past quarter century valued at more than $3 billion (the Imperial and Coachella valleys of southern California, the Yuma area of Arizona and California, and the Colorado River delta area of Mexico); it furnished a dependable domestic water supply at a re-regulating reservoir downstream for residents in the Los Angeles and San Diego areas, supplied directly by another engineering wonder, the 250-mile Colorado River Aqueduct of the Metropolitan Water District.

Lake Mead, behind Hoover Dam, and the 300-mile stretch of the river below it—that "altogether valueless" stretch explored by Lieutenant Ives—became a nationally important recreation area, attracting more people than Grand Canyon National Park, farther up the river.

Power from Hoover Dam and other hydroplants on the lower Colorado River proved vital in both peace and war, and helped make feasible the north-to-south, nation-spanning, extra-high voltage, direct-current power intertie now under construction from the Pacific Northwest to the Southwest.

Building Man-Made Rivers

Early Reclamation projects, located throughout the West, were generally small and single purpose in scope. The era of the large, multiple-purpose development began during the 1930's with the Boulder Canyon (Hoover Dam) Project. A major feature of this project was the All-American Canal, a large man-made river across the moving sandhills above the Mexican border to the Imperial and Coachella Valleys of Southern California.

During the depression years of the 1930's, construction also began on the Central Valley Project (CVP) in California, now a $2 billion multipurpose development, and one of the greatest water projects in history. This project already delivers irrigation water to 1.3 million acres of valuable farmland (average annual yield per acre—$348), enough municipal water for 700,000 persons, and billions of gallons additionally for waterfowl conservation, fish propagation, water quality control, and other uses. In fiscal 1967 work began on the Auburn-Folsom Unit of CVP to provide water to more than 400,000 acres of prime farmland.

Some of the world's largest man-made rivers have been constructed along both sides of the 500-mile-long Central Valley to deliver to water-short areas about 3 million acre-feet (nearly 1 trillion gallons) of water annually from storage dams built by the Bureau of Reclamation and the U. S. Army Corps of Engineers. One of the reservoirs—San Luis—has just been completed as the first jointly shared facility of the Bureau and the State of California. The 103-mile San Luis Canal involved excavation of 57 million cubic yards or the equivalent of a 10x16½-foot trench from Denver to Boston. During the next 25 years, an additional 6 million acre-feet of water, or double that now being delivered by CVP, must be available annually to supply full demands in California.

Since completion in the 1940's of the Grand Coulee Dam in Washington, the largest concrete structure in the world, the Bureau of Reclamation has built irrigation works to deliver water to nearly half the 1 million acres contemplated for development in a section of desert land east of the Cascade Range in the Pacific Northwest—The Columbia Basin Project.

This project in central Washington grew from 608 irrigated farms in 1949 to 2,500 farms in 1966. Gross income from crops and livestock in the project area in 1963 totaled $76.2 million and net income was $29.8 million. Lakes, canals, drains, and other waterways and adjoining farmlands on the project also have become a haven for fish and wildlife. This man-made fish, wildlife, and recreation domain now comprises one-fourth the state's hunting and fishing resources.

A recent economic study of this project disclosed these contrasts between the irrigated greenbelt and an adjoining, comparable area of dry land farms:

...The irrigated project lands support 17 times the population and business establishments and more than 20 times the number of wage earners and total payrolls;

...With an assured water supply, the property tax base, which supports local, county, and State services, increased six-fold, and postal receipts, retail sales tax, and Federal income tax payments were 17 times greater than in the adjoining dry land area;

...Outbound freight shipments were 8 times greater and inbound shipments, 23 times greater.

These highlights of a university economic study underscore the role played by water resources development in a sparsely settled semi-arid area.

Reclamation's man-made rivers are truly "liquid gold."

Taking Water Through Mountains

One of the first projects undertaken by the Reclamation Service was the Strawberry Valley Project, a transmountain diversion of water in Utah. This project involved drilling a 19,000-foot tunnel under a crest of the Wasatch Range to bring water from the Colorado River Basin into central Utah in the Great Basin. That pioneering project of 1906-1912 is now being enlarged as part of the central Utah development of the 10-year-old Colorado River Storage Project.

The success of this and comparable projects led the Bureau of Reclamation to undertake in the 1940's one of the boldest transmountain diversions ever conceived. This was the Colorado-Big Thompson Project, which originates in the snow-clad peaks of the Colorado Rockies and delivers water originally destined for the Pacific Ocean into the Atlantic-bound drainage system of the South Platte tributary to the Missouri River. Major feature of this $163-million project is a 14-mile tunnel under the Continental Divide. This project brought stability for the first time to the agricultural economy of much of northeastern Colorado and became the model and technical training ground for the Snowy Mountain Scheme, another transmountain diversion project now under construction in Australia.

Two other water diversion projects through the Continental Divide are underway in Colorado and New Mexico. These are Reclamation's Fryingpan-Arkansas Project to divert Colorado River water into the Arkansas River drainage for use on farms and nearby cities in a large area of southeastern Colorado, and the San Juan-Chama Project, to divert Colorado water for irrigation in the Rio Grande River Basin and for municipal supplies for Albuquerque.

Basin-Wide Development

Coordinated basin investigation and development have been pioneered in parts of the West, notably in the Missouri River Basin, the Colorado River Basin, the Columbia River Basin, and the Central Valley (Sacramento and San Joaquin River Basins) of California.

Two of these basins, the upper Missouri River and the Colorado, were included among the five western drainage basins that the Senate Select Committee on National Water Resources stated in 1960 would need to have their water resources fully developed by 1980 or earlier. (The other three basins that are rapidly running out of water are: South Pacific, Great Basin, and Upper Rio Grande-Pecos River.)

One of the great benchmarks in Reclamation history was established in fiscal 1967 when work was started on the $266-million multipurpose Garrison Diversion Unit in North Dakota, latest development under the 10-State Missouri River Basin Project, originally authorized in 1944.

Another Bureau of Reclamation accomplishment during the past year was the substantial completion of Yellowtail Dam on the Bighorn River in Montana, largest and highest dam on the headwater tributaries of the Missouri River. This project already is returning flood control, hydropower, and recreation benefits.

In the Upper Colorado River Basin, the Bureau and participating states (Arizona, Colorado, New Mexico, Utah, and Wyoming) continued the reclamation work started a decade ago. Three of the major storage reservoirs are in operation—Glen Canyon (Lake Powell) in Utah and Arizona, Flaming Gorge in Utah and Wyoming, and Navajo in New Mexico and Colorado. A fourth storage unit, Curecanti on the Gunnison River in Colorado, is well along, with water already impounded behind Blue Mesa Dam, the largest of a trio of Curecanti storage reservoirs.

Five "participating projects," which bring water to farms and communities, are operating: Vernal Unit of Central Utah Project; Florida, Paonia, and Smith Fork projects in Colorado, and Hammond Project in New Mexico. A sixth, Emery County Project in Utah, is nearly complete. Construction is underway on six other participating projects, including the Navajo Indian Irrigation Project, to bring water to the large and isolated Navajo Indian Reservation in New Mexico; the San Juan-Chama Project, a $320-million development in Colorado and New Mexico; and the Bonneville Unit of the Central Utah Project, which was started in March 1967 with the award of a contract for constructing Starvation Dam on the Strawberry River near Duchesne, Utah.

Total income of the Colorado River Storage Project up to July 1966 exceeded $21 million, largely from sale of hydropower. Ultimately about 85 percent of the cost of the billion-dollar development will be repaid by its water and power users.

Water for Farms and Cities

Reclamation supplies water to about one-fourth the irrigated acreage in the West.

The relatively small but vital fringe of irrigated greenbelt in the West comes into proper perspective when one considers that the United States has roughly 1 million square miles of what geographers would classify as "dry lands." This consists of much of the area west of the 100th meridian, which bisects the Dakotas and runs generally along the eastern side of the Texas Panhandle. In much of this great area, save for the extreme Pacific Northwest and the "humid islands" created by snow-trapping mountain peaks, rainfall is insufficient to produce crops that mature later than early July. Irrigation with stored water is necessary to produce many crops, lawns, gardens, and many species of trees and shrubs. Annual precipitation in this zone averages about 20 inches, one-third less than the national average, and ranges downward to less than 4 inches in the desert Southwest.

In areas of extreme aridity, such as California's Death Valley, an entire year may pass with no rainfall, and at Baghdad, California, during a record three-year dry spell, only one-tenth of an inch of rainfall was recorded. Western droughts occur not only each summer, but for periods of years lasting up to a decade, or more; hence Westerners must store excess water in wet years to have it for use during prolonged dry spells.

Heavy demands on limited surface water storage frequently are accompanied by increased use of pumped supplies from the ground. Failing groundwater supplies and urban expansion into irrigated lands have resulted in loss of some of the nation's most productive farmlands in three major western areas. These areas, where irrigated acreage is declining, are the High Plains area of Texas, the Central Arizona area, and the southern California coastal area. Federal and state agencies are seeking ways to relieve this forced rollback of limited western greenbelt.

This type of agricultural water "rescue service," to provide supplemental irrigation supplies to farm areas inadequately served, has characterized much of Reclamation's irrigation operations. Production of water for raw lands has declined since the early days of Reclamation. However, there remains a substantial potential for irrigation expansion to dry land areas in northern and central California, the Pacific Northwest, and the Missouri River Basin, where adequate in-basin water supplies exist.

Throughout the West, however, there remains a large unfilled need for supplemental water for irrigation, and for municipal and industrial requirements. The summer of 1967, for example, saw the first water deliveries from a new Reclamation reservoir near Amarillo, Tex., through a 322-mile aqueduct system being built to serve 11 Panhandle cities with municipal water. Another similar project supplies Norman and Oklahoma City, Okla., and one has just been started to deliver additional water to Las Vegas, Nev. Deliveries of municipal and industrial water by Reclamation have doubled in the past eight years. During 1966 some 49 multipurpose projects provided 588.7 billion gallons of water for municipal, industrial, and other non-agricultural uses. This was an increase of 42.6 billion gallons over the previous year. More than 13 million urban dwellers are now using water from Reclamation projects.

Water Recreation for Desert-Dwellers

In early Reclamation projects recreation was strictly a byproduct. But waterways in the desert naturally

The lake above Shasta Dam in Reclamation's California Central Valley Project provides storage for river regulation, irrigation, recreation and flood control.

Water over the dam on April 22, 1965, at Horseshoe Dam in the Salt River Project, helps relieve the highest runoff on the Verde River since 1941.

attract fishermen, boating enthusiasts, picnickers, campers, and other recreationists. Some early Reclamation reservoirs today are among the best fishing holes in the West. Statistically, use of 219 Reclamation areas administered for recreation in 1966 totaled 44.9 million visitor-days, an increase of 8.3 million, or roughly 20 percent, over 1965.

Folsom Lake in California, with 4.4 million visitor-days, has overtaken Lake Mead, long the most popular Reclamation lake, but whose 4.3 million visitors in 1966 were only enough for second place.

Many new public facilities at Bureau of Reclamation projects have been built by Job Corps Conservation Centers, 9 of which are operated by the Bureau in 8 western states. These camps have a capacity for 1,613 corpsmen, who spend about 40 percent of their time in work programs developing outdoor recreation facilities on public lands and in the conservation of natural resources. The Corpsmen have built roads, cleared underbrush, built boat ramps and other picnicking and camping facilities, planted thousands of trees, shrubs and flowers, and constructed many check dams, revetments, and other erosion-control structures. They have assisted in cleanup after tornadoes and floods, searched for lost children, fought fires, and performed other community and emergency functions. The Corpsmen earned considerable community goodwill with these efforts, and still were able to devote 40 percent of their time to educational classes and vocational training.

Tapping the Rivers of the Sky

One of the most challenging new efforts of Reclamation is "Project Skywater." This long-range research and development program, started in 1962 is aimed at increasing controlled precipitation from the atmosphere to help meet needs in water-short areas throughout the country.

In requesting an expanded research program in atmospheric water resources in early 1967, Secretary Udall described the atmosphere as a "fourth dimension" in man's never-ending search for potable water supplies. He said "We must learn how to manage our rivers of the sky for water supply, just as we have learned how to manage our surface waters, our underground waters, and the ocean. These four sources of water are all interrelated. Each feeds the others and each draws from the others in a never-ending hydrologic cycle. We must learn how to tap this cycle as needed in order to meet our future water requirements."

Active in atmospheric water resources research since 1961, the Bureau of Reclamation and the Department of the Interior in late 1966 published a report, *Plan to Develop Technology for Increasing Water Yield from Atmospheric Sources.* It outlines a plan for developing systems to step up precipitation in some areas by 1972 and for achieving a general national capability to increase or redistribute precipitation by 1985. This proposed program was facilitated by 1966 reports on weather and climate modification by the National Academy of Sciences and by the National Science Foundation. The NAS report concludes there is considerable evidence we can improve on nature, under certain meteorological conditions, to the extent of a 10 to 20 percent increase in water yield from the atmosphere over areas as large as 1,000 square miles. Both reports recommended establishment of a greatly expanded program in all phases of weather modification. The Bureau's technical efforts are coordinated ecologically. Studies are also being made of the complex legal aspects of weather modification.

The Bureau's atmospheric resources research, and other aspects of engineering design and research, will be directed from a new 14-story center just completed west of Denver, Colo.

The staff of the Bureau's Denver center planned and designed the 397 dams and dikes that have been built or are under construction by the Bureau of Reclamation. Collectively, they provide reservoir storage for 135 million acre-feet of water—the equivalent of the yearly flow of nearly 14 rivers the size of the mighty Colorado. Transported by more than 40,000 miles of canals and lateral ditches, this water is delivered to 134,000 farms comprising more than 8 million irrigated acres and producing crops valued at more than $1.5 billion a year. An additional 520.7 billion gallons of water is provided for municipal and industrial use to communities with a combined population of 13 million.

The Reclamation power system includes 50 hydroelectric plants with a generating capacity of 7 million kilowatts. The power is delivered to customers by the Bureau's transmission system which includes 15,000 circuit miles of transmission line, and 315 substations having a capacity of 18 million kilowatt amperes.

To anticipate and meet the growing needs for water and power, the Bureau of Reclamation has a record of engineering ingenuity and enterprise. At five different times in its history, Reclamation has designed and built dams higher than any then in existence in the world. It has built the nation's largest powerplant, and that plant—Grand Coulee in the State of Washington—is now being enlarged from 1.9 million kilowatts to a potential 9.2 million kilowatts, which would make it again, by far the largest generating plant in the world.

The Engineering and Research Center is studying new areas of water resources development. These include: Evaporation suppression, or the means of reducing the loss of millions of gallons of water to the atmosphere; weather modification, where precipitation can be induced under controlled conditions by cloud-seeding methods; reuse of irrigation water; and evaluation (in cooperation with the Office of Saline Water) of economical desalting processes. Also, control of phreatophytes, plant growth which steals water by the thousands of gallons; water quality and pollution control, to assure delivery of usable water for municipal and industrial purposes; savings of water in transportation through the use of closed pipe systems; and power generation and transmission studies which will accelerate and make more economical the delivery of electricity between different areas of the country to meet daily, seasonal, and emergency demands.

The Denver Center is also the focal point for an international program of training and technical information exchange with other nations. As part of the international technical assistance activities of the U.S. Government, Bureau programs are maintained in all phases of water resource development. The services are funded by such sponsoring agencies as the Agency for International Development, the United Nations, appropriate embassies, or, in some cases, by the participants' home organization. More than 1,500 engineers, economists, and geologists from some 60 foreign lands have been trained by the Bureau and have returned to develop the water resources of their own countries. This group includes Prime Minister Suleman Demirel of Turkey, who spent several months here as a Reclamation trainee before rising to his nation's highest office.

More than 5,000 foreign technicians and observers also have visited Reclamation installations. Reclamation advisers have been assigned to a score of foreign nations to assist in their self-development.

Art and Architecture

A board of consultants on art, architecture, and landscaping recently was appointed by the Bureau of Reclamation to advise the Bureau on matters pertaining to design and aesthetics in the planning and construction of major water resource projects in the West. The Bureau seeks the counsel of these experts on questions of site planning, architecture, landscaping, and art work in visitor centers and other Reclamation structures in order to implement the national effort for the preservation and enhancement of natural beauty.

The six-member group of consultants is working with the Bureau on the Third Powerplant at Grand Coulee Dam and on the Auburn-Folsom South Unit in California.

Federal Water Pollution Control Administration

Water flows through all the problems facing man and his environment.

Jampacked schools spew forth students looking for space and beauty. Riots turn city streets into noisy barometers of urban unrest. Shoeless youths with long locks flowing hunt for happiness among drugs and downbeat living.

Workers seeking a break in the monotony of assembly-line existence, battle their way through waves of cars to reach an already crowded countryside. Businessmen run from the crime and crowding of the city's core to fall victim to suburban sprawl.

It is getting harder and harder to get away from it all. Problems we run away from today return to haunt us tomorrow.

The longing and the anguish, the searching and running can be traced to the pressures of modern life upon man, his environment and resources. If man is not to become the endangered species, he must learn to improve that environment. The likelihood of pleasant living then will increase.

To achieve this harmony, man must learn that even a small amount of water pollution, when added to a little air pollution and mixed with the noise, dirt, and congestion of everyday life, can make that life intolerable.

The cumulative effect of the degradation of our environment must be kept in mind while we review the new advances made toward controlling one resource.

The need for more elbow room, a chance to enjoy Nature to the fullest and to restore the bounce to everyday life, has placed additional demands upon our already overburdened water.

Formerly, it was a matter of more clean water to use in our homes, more water for industry to produce the many luxuries that have become necessities in 20th Century living, or more water for the farmer to reap the abundance of our lands.

Now these uses are taken for granted. The new element in managing our water concerns man's desire for a fuller life.

The city dweller wants easy access to a lake or stream for a picnic, for boating, fishing, swimming or water skiing. There are 8 million private boats in the United States and the number grows every day.

Pressures built up in urban living can find release along the lakes and streams of the countryside if the water and surrounding land are clean and attractive.

Now the additional demands upon the water have brought a time of decision to America.

During the past months, communities and states across the land have been meeting, discussing and debating what uses they want to make of their water. They have been determining the quality of water for all the interstate and coastal waters of the United States.

Besides setting the quality of the water, the states spelled out how the uses would be achieved and how this program would be enforced. When fully enforced, the new rules for clean water will be the basis for the nation's first all-out war on water pollution.

Although the water quality standards are set by the states and enforceable by them, the Federal Government must approve them, and in the absence of enforcement, will see that the violators mend their ways.

The Federal Water Pollution Control Administration (FWPCA) has been assisting the states during preparation of the standards. Besides furnishing guidelines, the FWPCA has provided information on the technical aspects of pollution and, in some instances, loaned personnel to state agencies developing standards.

Five national technical advisory committees provided scientific requirements for water used for agriculture, for recreation and aesthetics, industry, public water supplies, and aquatic and animal life.

Because of the size and the complexity of the United States, the standards will vary from area to area, from river basin to river basin and even within a river, but there will be a consistency, a compatability, and especially a rationality to any such variations.

With all the variations, the basic purpose to be achieved in setting water quality standards is to preserve those waters that are still clean and to restore to suitable levels of cleanliness those waters that have become polluted.

To achieve these goals, the Federal Water Pollution Control Administration has divided the nation into 20 major river basins (a river basin plan for water pollution control is simply a program that takes into consideration all the factors and forces affecting the water within the basin).

For an effective comprehensive plan, one must know or project the water uses of the area. He must know what kinds and amounts of wastes are reaching the water, how the area's population will expand, how the land will be developed, what industry and agriculture are planning in the watershed, and what political and social influences are at work.

$105 Million Program to Clean Up Willamette

The Willamette River Basin in Oregon is a good example. A comprehensive report for the Willamette has been completed and a $105 million program to curb pollution has been recommended. The report states that under present conditions the use of the Willamette River for water supplies is severely limited, recreation is curtailed, and trout and salmon catches have declined.

One-third the recommended amount would be spent to reduce the quantities of wastes reaching the water from pulp and paper mills, the single most serious source of pollution in the basin. The rest of the money would be used to curtail wastes from cities and industries other than pulp and paper producers.

Culminating several years of detailed study of the entire basin, the report reveals the extent and cause of water pollution and spells out what must be done, not only to abate pollution but also to prevent its recurrence.

As part of the comprehensive river basin programs, more than 100 reports on immediate pollution control needs around the nation have been prepared by FWPCA. These documents will focus attention on major problems and help start the clean-up of pollution sources.

The heart of the nation's water pollution control is in the construction of sewers and waste-treatment facilities by cities and states and the control of industrial pollution through waste treatment, process changes, or both. In many cases, municipal and industrial pollution control can be a cooperative undertaking.

The FWPCA has a double-barreled weapon to encourage the construction of treatment plants. One barrel is enforcement, the other is financial grants to communities.

Primary responsibility for enforcement of pollution rests with the states, but, unfortunately, many of the states have not pursued regulation vigorously. Consequently, FWPCA has had to start enforcement actions where pollution from one state resulted in damage to the waters of another state.

With the passage of the Water Quality Act and the establishment of water quality standards throughout the nation, enforcement has taken on new meaning and strength.

No longer will it be necessary to wait until a stream or lake has become polluted and then prove that the public health or welfare is in danger. Hereafter, anyone who persists in dumping into water wastes which reduce or threaten to reduce the quality of the water below the standards which have been set by the states is subject to legal action.

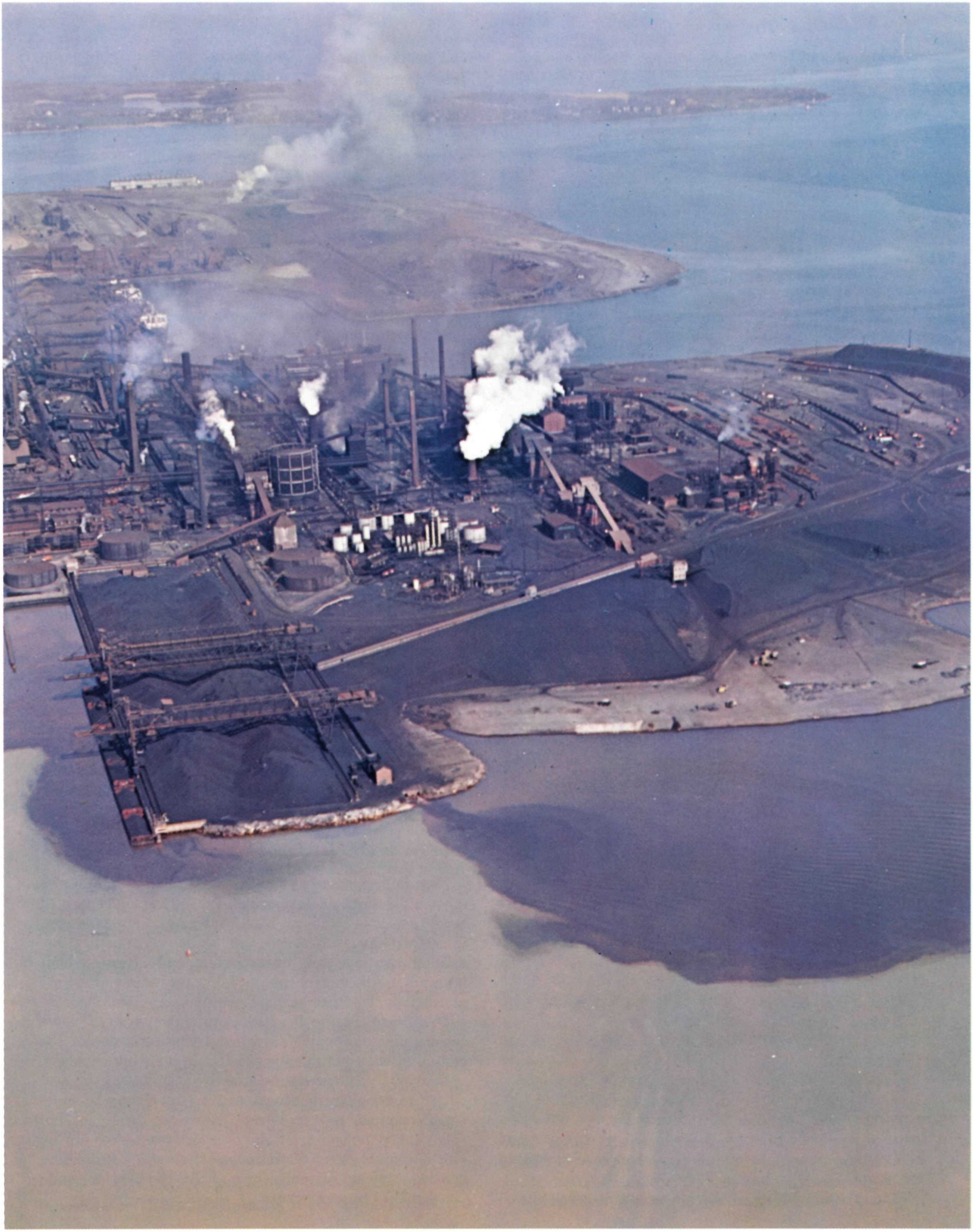
During the time the states have been deciding upon water uses, the enforcement arm of FWPCA has not been inactive. On the contrary, four new conferences have been held and enforcement conferences have been reconvened or progress meetings held on six other pollution situations.

Two of the new enforcement actions represented the first application of authority granted by the Water Quality Act to stop within-a-state pollution that interferes with the interstate marketing of shellfish. These actions involved the waters of Moriches Bay and the eastern section of the Great South Bay, Long Island, N.Y., and the Penobscot River and Upper Penobscot Bay in Maine.

As an example of the action taken at a typical conference, the report on the Long Island pollution recommended the widening and deepening of the inlet connecting Moriches Bay to the Atlantic Ocean. Closure or partial blockage of this inlet as a result of Atlantic storms in the past has sometimes kept sea tides from sweeping cleansing waters into the bay.

The report also recommended operation of adequate treatment facilities at all duck farms to reduce pollution from poultry and the pumping of dredged duck wastes into the ocean during the late fall, winter, and early spring under controlled conditions. The wastes would have to be discharged at least 1½ miles out to sea from Moriches Inlet to avoid possible contamination of bathing waters off the Fire Island National Seashore.

The other two new enforcement actions were started to deal with the pollution of the Chattahoochee River



Like great purple bruises, industry's wastes discolor and pollute the waters of Chesapeake Bay.

in Alabama and Georgia and to prevent further pollution of Lake Tahoe in Nevada and California.

Among the reconvened conference sessions, one at Buffalo, N.Y., resulted in a far-reaching agreement on remedial action to save Lake Erie. This single action, involving 54 municipalities and 80 industrial firms, was the largest in terms of total impact since the beginning of the enforcement program in 1948.

Once it has been decided what measures must be taken to clean up pollution, cities and states face the problem of financing the construction of waste treatment plants.

Since the passage of the first legislation—the Federal Water Pollution Act in 1956—the Federal Government has been helping communities build treatment facilities through construction grants. The amount of aid available has been progressively increased since then.

But, despite the progress of past years, it became evident that much greater rates of sewage treatment plant construction would be necessary. Construction would have to be stepped up to overcome the backlog of needed facilities, to fulfill the needs resulting from new population growth, and to replace plants as they become obsolete because of age or technical inadequacy.

Noting this increased need, Congress authorized a much more liberal program in the Clean Water Restoration Act. Now, the Federal Government can finance 30 percent of the cost of an approved project with no dollar ceiling on an individual grant.

Atop this, the federal share can be increased to 40 percent if a state is willing to pay 30 percent of the cost of all projects for which federal sewage treatment plant construction funds are available.

Further, if a state adopts enforceable water quality standards for the stream in which a proposed treatment plant discharges, the Federal Government can provide 50 percent of the cost of a project, reducing both the state's share and the city's share to 25 percent.

If a project conforms with the comprehensive plan for a metropolitan area, an additional 10 percent of the amount of a grant is provided by the Federal Government.

By taking advantage of these additional incentives, communities could receive 55 percent of the cost of a project from the Federal Government. The city would then pay only 20 percent of the cost, the state 25 percent.

Of particular significance to the larger metropolitan areas is the removal of the dollar ceiling on grants. In the past, the federal share of any project was limited to $1.2 million regardless of the project's size.

The Federal Government now can pay up to 55 percent of the cost of any size project, the only limit being the amount of total federal funds allocated to the state.

Since the beginning of the aid program, the Federal Government has furnished $930 million to help build 7,860 projects, costing a total of $4,173 million.

Through the construction of new municipal waste-treatment plants and the modernizing and enlarging of existing plants, the problem of municipal wastes ultimately will disappear as a major pollution problem.

At the same time, efforts to control industrial pollution also are being intensified. The nature of their wastes and the large amounts of water some industries must use in production and cooling operations make industry a formidable polluter.

When industry approaches this problem, the cost of treatment or other means of preventing pollution becomes of paramount importance. If the costs are too great, an individual plant or firm may not be able to remain competitive.

Realizing the many unknown cost factors in pollution control, Congress, in the Clean Water Restoration Act, ordered a cost study by FWPCA. As part of the survey, FWPCA has launched a special study—called an industrial waste profile—to provide more information and suggest ways industry can meet its responsibilities in the growing offensive against pollution.

For purposes of the study, industry was broken down into major groups, such as meat products, dairies, basic chemicals, fibers, plastics, rubbers, and fertilizers. Contracts have been negotiated with research firms and universities to conduct profiles of each particular section.

From these studies, FWPCA will learn how much waste results from each manufacturing process, how improved methods of processing might reduce the amount of wastes to be treated, and how much each of the processes cost.

Also, it will become apparent how effectively present treatment systems are working, how these methods could be improved, and how much this is going to cost.

Finally, the study will suggest ways of developing new products from some of the waste materials.

New Ideas to Solve Combined Sewer Problems

New approaches have been taken against one of the most difficult problems in pollution—that of combined sewer systems handling both sewage and storm water. Combined sewers overflow during heavy precipitation, spilling raw sewage into streams and rivers. About 59 million Americans live in 1,900 communities where at least part of the sewage systems are combined.

Overflows occur because combined sewers have escape openings which permit automatic release of the contents when volume exceeds their carrying capacity.

Previously, planners believed the only way to deal with the problem of storm water runoff was to build separate storm water sewers. However, this does not solve the pollution from surface wastes picked up by storm water runoff. Moreover, the cost of building separate sewer systems throughout the Nation could run to $30 billion or more.

The Water Quality Act authorized $20 million annually over a three-year period for research and demonstration of new and improved methods for controlling this type pollution.

Some new ideas are being tested:

Sewer within a sewer. Small tubes are installed inside combined sewers to carry finely ground sewage under pressure to interceptor lines for transportation to treatment plants. Combination grinder-pump units are being developed for both household and commercial discharges. The American Society of Civil Engineers is carrying out this project under a $348,500 grant from FWPCA.

Detention and chlorination. The Metropolitan District Commission of Boston is building a storm water chlorination basin on the Charles River. By detaining the water until it can be treated, the usual massive increases of bacteria reaching the river will be prevented and the buildup of sludge on the river bottom will be reduced. A $1 million grant from FWPCA is helping build the basin.

Deeper detention basins. The East Chicago Sanitary District will construct a 20-acre detention basin with the unusual depth of 40 feet. Most such basins are only 4 to 8 feet deep. Added depth means waste material in the upper levels will be attacked and decomposed by a bacteria which thrive in water containing dissolved oxygen while a different type of bacteria which survives in a non-oxygen environment will consume wastes at lower levels. Included in the project, for which the FWPCA made a $1 million grant, is installation of 9 mechanical aerators to force oxygen into the upper levels of the waste water. The basin is expected to reduce significantly the pollution in waste water discharged into the Grand Calumet River, which flows into Lake Michigan.

Lowering ground water level. Meridian, Idaho is studying feasibility of digging wells to lower ground water level in hopes this will reduce infiltration into sewer lines. The seepage of ground water into combined sewers overloads the sewage treatment plant and causes sewage to back up into homes. FWPCA is supporting tests with a grant of $18.375.

Deep tunnel system. Chicago is constructing a system of deep tunnels to store storm water temporarily. When the rain stops, the storm water would be pumped back into the sewer lines for delivery to sewage treatment plants. The FWPCA is supporting the project with a $1 million grant.

Polymers or polyelectrolytes. This relatively new family of chemicals is being tested for speeding the flow of sewage through pipes. When placed in sewers, the polymers reduce friction, causing the waste water to flow faster. This, in effect, increases the capacity of a sewer system without additional construction.

Oil Slicks Spread Pollution Evils

When the tanker Torrey Canyon ran aground off the coast of Great Britain in 1967, spilling about 30

Photo by W. Strope

Some 5,800 miles of streams (about 57,000 acres) and 29,000 acres of reservoir surface are troubled by acid mine drainage. Its reds and yellows spell beauty in a rainbow but death in a river.

million gallons of oil, a problem that has been a growing danger to our environment for years became dramatic, front-page news.

The threat to fish and wildlife, the beaches, and even man himself, was brought home to England as well as the rest of the world. Spills along the Atlantic and Pacific coasts added to the demands for action against this growing threat in the United States.

The Federal Water Pollution Control Administration has been spearheading the comprehensive program against oil pollution since passage of the Clean Water Restoration Act in November, 1966.

Larger and larger amounts of oil are being moved across the seas—now about a billion tons a year—and the tankers also are far larger. The Torrey Canyon's load of 30-million-gallons will be dwarfed by the 125-million-gallon capacity of future tankers.

Most oil spills occur in estuaries, bays, sounds, marshes, and coastal waters. These areas are of critical importance in the whole food chain and in the production of plant life, shellfish, sport and commercial fish, waterfowl, and shore birds.

Few estuaries escape contamination from oil pollution in any year. Serious damage often occurs and is increasing because most drilling rigs, tank farms, and docks are on or adjacent to estuaries.

In the United States there are approximately 100 handling terminals and 900 commercial and naval shipyards where oil can be loaded or unloaded. In addition, there are about 62 tank-cleaning companies.

The thousands of automobile service stations across the United States are potential pollution sources when they dispose of their oil wastes improperly. Moreover, these wastes are not simple base oil, but also contain detergents and other chemicals which either were present in the fresh oil or were added to the crankcase by the motorist. These compound the degrading effect on water quality and make the cleanup more difficult.

The FWPCA is taking a broad range of actions to solve the oil problem. The chief ones are:—Stepping up enforcement of the Oil Pollution Act. —Exploring the possibility of stockpiling oil-control and removal equipment at strategic locations throughout the nation. —Cooperating with representatives of the oil, ship, and chemical industries to review technical aspects of oil pollution and to outline a future course of action. —Working with the U.S. Army Corps of Engineers and the Coast Guard to carry out provisions of Oil Pollution Act. FWPCA regional offices are providing laboratory support and helping prosecute violators. —Coordinating a research and development program with the Coast Guard and Corps of Engineers.

Scientists Seek Better Ways to Purify Water

Many of the water pollution problems facing America today can be alleviated by the wider application of existing technology. In fact, during the next five years or so, the greatest strides will undoubtedly be made in this way.

It is equally clear that future population and industrial growth and concentration, changing land uses, and increasing demands on our limited water resources are pressing us for much better techniques for cleaning used water.

New types of pollutants—such as hard-to-treat organics, radionuclides, nutrients, viruses, inorganic salts, even heat—are placing additional burdens on waste treatment. The effects include over-fertilization of water, interference with water treatment or industrial use of water, tainting of fish flesh, fish kills or other damage to stream life, taste, odor, color or foam in water supplies, and potentially, even damage to man.

Each water use adds certain amounts of wastes that are not removed by present-day biological treatment. If we are to meet our future needs through repeated use of our fresh water supplies, much more of the impurities must be removed from waste streams.

To do this, FWPCA scientists are developing new processes, based on concepts and principles that will achieve complete conversion of waste water to fresh water. This has sparked a major research program, taking advantage of the best scientific minds in government, industry, and universities.

Advanced techniques under investigation range from the extension of biological treatment capable of removing nitrogen and phosphorous nutrients to physical-chemical separation methods such as adsorption, distillation, and reverse osmosis.

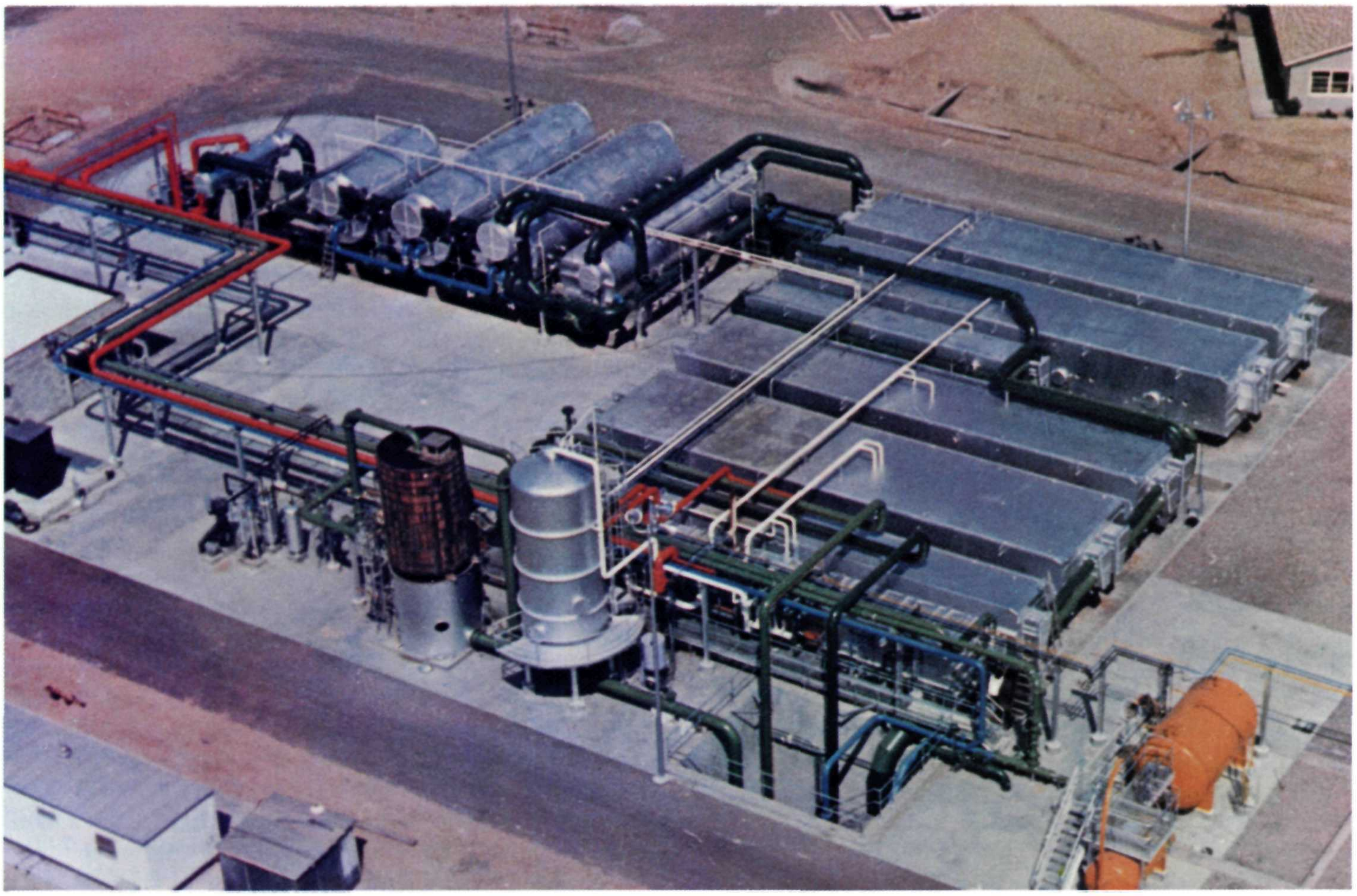
One of the more promising leads to complete water reclamation is reverse osmosis. When liquids with different concentrations of minerals are separated by a membrane, the cleaner water tends to pass by osmosis to the dirty or more concentrated water on the other side until both liquids have the same strength. If pressure is put on the side with the most minerals, the process reverses, forcing the clean water out of the more concentrated.

This is a reverse in more ways than one. It reverses a natural process, and it reverses the traditional approach to waste treatment: Instead of taking the impurities out of waste water, it takes the molecules of pure water out of the waste water.

So far, reverse osmosis has been tested for just a few hours on a small scale. Studies are now going on at a 5,000-gallons-per-day pilot plant to determine membrane life, biological effects on membranes, and other problems connected with the process. Reverse osmosis studies also are described in the section for the Office of Saline Water.

A new idea being considered is the possibility of applying different types of treatment on a "demand" basis to achieve the desired pollution abatement at a lower cost. This would mean that the more expensive methods would be used only for limited times.

With the development of really complete treatment techniques permitting recycle of renovated waste water for direct reuse, it is conceivable that some day we might have "dry" industries and municipal treat-



The 1 million gallons per day Clair Engle Plant at the San Diego Saline Water Test Station uses the most modern technology known to extend the economic potential of multi-stage flash distillation.

ment plants from which no pollution would enter either surface or ground water.

Significant changes in our whole water management field could result from the application of these new, advanced treatment methods. Some of the effects could: —Reduce the need for providing water to augment river flows. This extra water is now used to control pollution from presently untreatable wastes. —Insure continued economic growth and development in water-short areas. —Postpone the time and reduce the requirement for providing more water to an area through importation and desalination.

In short, advanced waste treatment will simultaneously help alleviate two of our major water resource problems—pollution and supply.

Office of Saline Water

As humans continued to increase at a gathering pace, man turned more frequently in 1967 to the oceans of the world for help in meeting his needs.

At the forefront of this new area of exploration is the great promise of producing from the oceans vast quantities of low-cost, pure, fresh water. A major step toward that goal was taken May 19, 1967, when President Johnson approved legislation authorizing $57.2 million for participation by the Department of the Interior in construction and operation of the world's largest desalting plant. Designed to produce 150 million gallons of fresh water per day, the plant will more than double the capacity of all the desalting plants presently operating on earth and provide sufficient water to meet the demands of a city the size of Boston or San Francisco.

The 150-million-gallons-per-day water factory will be built by the Metropolitan Water District of Southern California as part of a dual-purpose program known as the Bolsa Island Project. In addition to the desalting plant, the project also will include construction of an 1800-megawatt power plant, which will be able to produce one-third more electric power than Hoover Dam and will be sufficient to meet the electrical needs of approximately 2 million persons. To be built on a 43-acre man-made island, 2,800 feet offshore from Bolsa Chica State Beach in Huntington Beach, Calif., the dual-purpose plant will receive its energy for water and power production from two 3-million thermal kilowatt nuclear reactors.

The significance of this plant can be brought into focus when we realize that the largest single unit desalting plant now in existence produces 2.6 million gallons of fresh water per day at a cost of 85 cents per 1,000 gallons. The cost of desalted water at the Bolsa Island Project is estimated at 22 cents per 1,000 gallons!

The Atomic Energy Commission was authorized at the same time to contribute $15 million to the Bolsa Island Project. The desalting plant will be built by the Metropolitan Water District of Southern California and the power generating facilities will be constructed by the Department of Water and Power of the City of Los Angeles, the Southern California Edison Company and the San Diego Gas and Electric Company. Thus, in a single project, we have the unique participation of two Federal agencies, a State water authority, and one public and two private power companies.

A Thirsty City Turns To The Sea

The 2.6-million-gallons-per-day desalting plant mentioned is also a significant development of 1967. This plant, now operating at Key West, Fla., marks the first time a United States city has turned to the ocean for its entire regular municipal water supply.

The implications of the future potential of desalting were never clearer than in President Johnson's remarks immediately following the Israeli-Arab conflict when he stated on June 19:

"If the nations of the Middle East will turn toward the works of peace, they can count with confidence upon the friendship, and the help, of all the people of the United States of America. In a climate of peace, we here will do our full share to help with a solution for the refugees. We here will do our full share in support of regional cooperation. We here will do our share, and do more, to see that the peaceful promise of nuclear energy is applied to the critical problem of desalting water and helping to make the deserts bloom."

Certainly, water can do more to dampen the fires of war and tension than any other commodity, for its ready availability brings with it the possibility of irrigation, industrial development, and an improved standard of living.

Delegates from many of the 99 nations who gathered in Washington in May for the first Water for Peace Conference expressed a growing hope that desalting plants could alleviate critical water supply problems, and interest was high in obtaining information concerning latest technological developments.

Six years ago, when today's desalting technology was just emerging from the test tube, Paul G. Hoffman, Managing Director of the United Nations Special Fund, stated:

"The growth in the absolute and per capita demand for fresh water is not alone a U. S. problem; it is also an international problem of challenging proportion. Indeed, grave as forecasts are concerning the adequacy of present and future supplies of fresh water in the United States, when compared to the quantity of water available on a per capita basis in most other countries of the world, the United States is one of the water-richer countries. At least 60 of the 100 underdeveloped countries and territories associated with the United Nations face forms of water shortage which in time can only be met from non-traditional sources; that is, from brackish and salt water sources."

Fresh Water Resources Limited

It is obvious that in the not too distant future even a full and efficient use of all available fresh water resources will not cover the growing fresh water demand of the human race on this planet. From a quantitative point of view, the only large-scale sources of additional fresh water are the oceans and saline brackish water bodies.

While the Bolsa Island plant will bring into existence a desalting installation nearly 60 times as big as the largest plant in operation today, already it is being considered as a prototype of much larger plants to follow.

One of the most ambitious studies on the utilization of desalted water is now being conducted jointly with Mexico under the general auspices of the International Atomic Energy Agency. An agreement was signed in October 1965, calling for a preliminary assessment of the technical and economic practicability of a dual purpose nuclear power plant designed to produce fresh water and electricity for portions of the Mexica States of Baja California and Sonora, and of Arizon and California in the United States. The water requirements of the area, together with the projected demand for electrical power through the year 1995, and a preliminary determination of the technical and economic feasibility of meeting those requirements with dual purpose, nuclear-powered, desalting plants is underway.

The area under consideration consists of a highly arid, broad valley composed of very fertile, highly permeable soil. Portions of this valley are irrigated with water from the Colorado River and underground aquifers. The significance of this study lies in the fact that the projected demands for water are very large, based on rapidly growing municipal and industrial needs, together with the potential for greatly expanded agricultural uses. For the purposes of providing an economic yardstick, the study team has chosen a unit plant size of 1 billion gallons per day, and to satisfy the potential demand for water through 1995 by desalting the waters of the Gulf of California, it appears that several such plants would be necessary!

Engle Plant Features Economies

Actual construction underway in 1967 leading toward the completion and operation of large dual-purpose desalting plants includes the 1-million-gallons-per-day Clair Engle Plant at the San Diego Saline Water Test Station. This plant uses the latest desalting technology and operating techniques to extend the economic potential of multi-stage flash distillation through higher temperature operation and increased fuel economy. A necessary precursor to the Bolsa Island Plant is the fabrication and operation of a 17-million-gallons-per-day test module. A module is simply a slice of a full-scale plant in which the engineers construct all equipment to full-size, but build only a sufficient part of the complete unit to obtain verification of design and to develop operating characteristics. The module, which is also under construction at San Diego, will have a fresh water production of about 2.5 million gallons per day, but it will simulate the operation of a full plant. The module will cover an area of 260 feet by 105 feet; the brine pump will handle 77,000 gallons per minute and will require a 5,000 horsepower motor.

Although much effort and attention are being directed to the development of large sea water desalting plants, the engineering development of smaller plants, particularly for the conversion of brackish waters inland, is not being ignored. High priorities have been assigned by the Office of Saline Water in its research and engineering divisions for the continued development of the promising reverse osmosis process. Just a few years ago, the Office of Saline Water, through a contract awarded to the University of Florida, was able to develop a synthetic osmotic membrane which would reject dissolved salts in solution and allow only fresh water to pass through the membrane.

After testing hundreds of different chemical combinations, a specially treated cellulose acetate membrane was developed which permitted fresh water to pass through when pressure was applied to the saline resolution. Even though the fresh water thus obtained was measured in microliters per day per square foot of membrane surface, it was a major scientific achievement.

As scientists developed a better understanding of exactly what occurred inside that thin sheet of cellulose acetate to accomplish this separation, they were able to design new membranes which incorporated improved salt rejection and water flow properties.

More Effective Membrane Sought

Pilot plants as large as 50 thousand gallons per day are now being built and tested and several different configurations and designs are being investigated. Operating on brackish waters, the fresh water capacity of a square foot of membrane surface has reached 25 gallons per day and there is now reason to believe that membranes will be successfully developed for sea water application. While a broad reverse osmosis test program is underway, basic research studies of the molecular structure of cellulose acetate and other types of membranes continue to be supported in an effort to achieve an even more effective membrane.

The development of crystallization processes has now reached a point where there is no question that plants can be built based on the vacuum freezing processes, but it is still not certain which of the crystallization processes finally will offer the best answer. Because of the very attractive energy efficiencies and the freedom from corrosion and scale that they offer, crystallization processes are potential contenders for small sea water units as well as having special merit for some of the more difficult brackish waters.

Commercial saline water conversion is already a fact, and industry has assessed it as a basis for profitable expansion and diversification. While desalting plants today provide only a tiny fraction of the world's fresh water, the recent technological and economic advances have attracted the interest and attention of municipal and industrial planners who are responsible for tomorrow's supply of fresh water.

It is clear that desalting is finding a place of increasing importance and will provide the cheapest or only alternative means of obtaining new water in many situations. Significant reductions in the cost of desalting have been achieved. Certain process technologies are ready to be employed on a large-scale basis and other processes are under development with an ultimate goal of achieving economically acceptable desalting systems for any world location.

Office of Water Resources Research

The Office of Water Resources Research (OWRR) administers the nationwide water resources research and training program. Its research is completely extramural. Support is provided on a continuing basis through annual allotments to an approved water resources research center or institute in each State and the Commonwealth of Puerto Rico. Since these centers are encouraged to develop cooperative arrangements for the participation by other universities, the total number of institutions now involved exceeds 100.

Annual allotments to the centers are supplemented by grants in which Federal funds are matched by non-Federal funds for specific research projects. Additionally, OWRR is authorized to arrange with any competent institution, private firm, individual, or public agency to study any aspects of water problems where research is needed. Thus the Act provides for research in areas outside the assignments of specialized, single-purpose water resources agencies—areas that might be neglected as a result.

This cooperative Federal-State program, although underway for less than three years, has made important contributions to the water resources field. The Federal funding has, in many instances, served as seed money to attract other support. Talented individuals from many scientific disciplines, who previously had not undertaken water resources research, have become participants. Universities have responded vigorously to the need for improved scientific and engineering research and training by developing new facilities, obtaining more sophisticated equipment, employ-ing new staffs, and offering new courses. A few of these courses, as in water law, have been outgrowths of research projects supported by federal funds. More than 1,300 students serving as research assistants under qualified project leaders obtained financial support annually through the program and received valuable training in the water resources field.

Work in all the major research categories described by the Water Resources Committee of the Federal Council for Science and Technology (FCST) is included in some 600 active projects supported by OWRR funds. Special attention is being given, however, to water resources planning methodology; socio-economic water problems; legal, institutional, and political aspects; urban hydrology; the ecological effects of water developments; and other areas which the FCST's authoritative state-of-the-art reports sponsored by OWRR, and other sources indicate should be accorded high priority.

Findings from such studies, which, after one or more years of support, were completed in 1966 or 1967, are being used in improved water planning and management. A water law research project conducted by the Cornell University Center, for example, resulted in a New York State statute clarifying the law as to private riparian rights.

Bonneville Power

How does one build a high voltage transmission line through some of the most scenic country in North America without spoiling the view?

You can hide the line behind a hill wherever you can.

Where no hill is handy, you can put the line high above the highway where only a motorist in a convertible can see it, and he may have to look up sharply.

You can study every available route over and over again, even if it means another trip on horseback or a grueling trek on snow shoes.

You can develop a clever new method for clearing the right-of-way, using aerial photos to mark a minimum of individual trees for removal.

You can sandblast the shine off the gleaming aluminum cable that will become the conductor.

The Bonneville Power Administration (BPA) is doing all these things, and more, in constructing a new transmission line into the heart of the fabulous Jackson Hole country of Wyoming. Because of a burgeoning tourist industry, the old line that parallels the Snake River can no longer supply the electricity needed by Lower Valley Power and Light, the cooperative that serves the area.

No one wanted to cut a fresh swath along the Snake, where the highway carries a heavy flow of tourists and the river is a favorite place for float trips. So after much discussion and many field investigations, the U. S. Forest Service and Bonneville, choosing from the five best routes, decided on a plan that will give the $3.3-million line the least exposure to public view.

The new line will tap the Palisades-Goshen circuit in a draw in the wheatlands near Swan Valley, Idaho. After the first five miles, the route leaves the farmlands, disappearing into the sparse trees of Pine Canyon. As it climbs toward Teton Pass, the line will pass through stands of ponderosa and lodgepole pine, tamarack, fir, and aspen. The timber becomes denser and at an elevation of some 6,000 feet the trees take on the exquisite qualities of alpine growth.

At the top of the pass, the highest point on the BPA system, the line will be 8,624 feet above sea level. From Teton Pass the line will descend, concealed behind the sharp crest of Phillips Ridge and visible from the valley only as it comes down the final slopes into Teton Substation, five miles short of Jackson Hole.

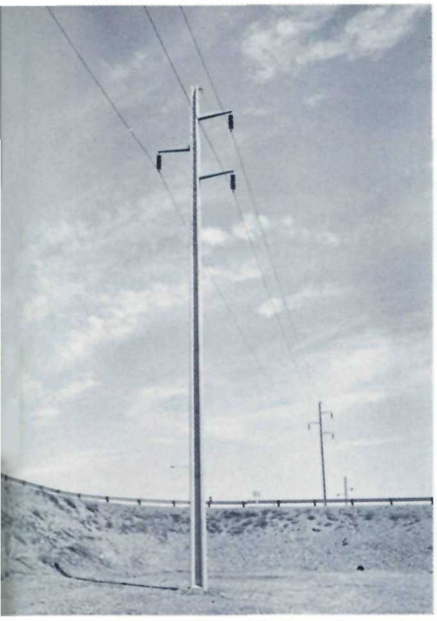
Light for a Lovely Valley

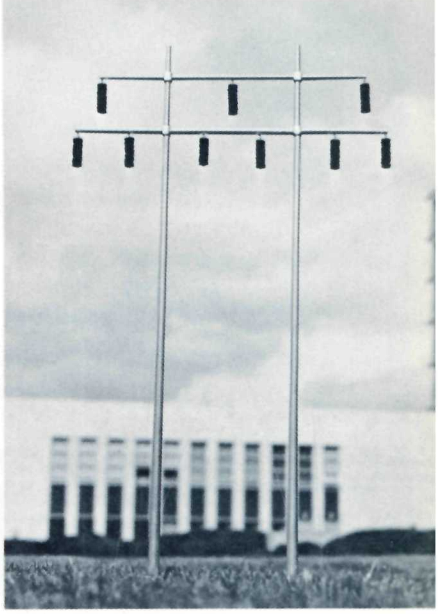
Jackson Hole is in a deep valley under the towering pinnacles of the Tetons. The Crow and Shoshone hunted here before James Colter discovered it for the settlers in 1807. The community grew from a trading post where the Indians and white men rendezvoused. Today the vicinity is being transformed by multimillion dollar recreation facilities, and the demand per customer for electricity has soared 14 per cent in the past year. The new and larger line will begin delivering power in November 1968.

When a BPA contractor began clearing the right-of-way for the new line in the summer of 1967, the men felling trees carried maps which showed every tree to be cut in areas judged scenic. It was the first time in BPA's 30-year history that such scenic precautions have ever been taken.

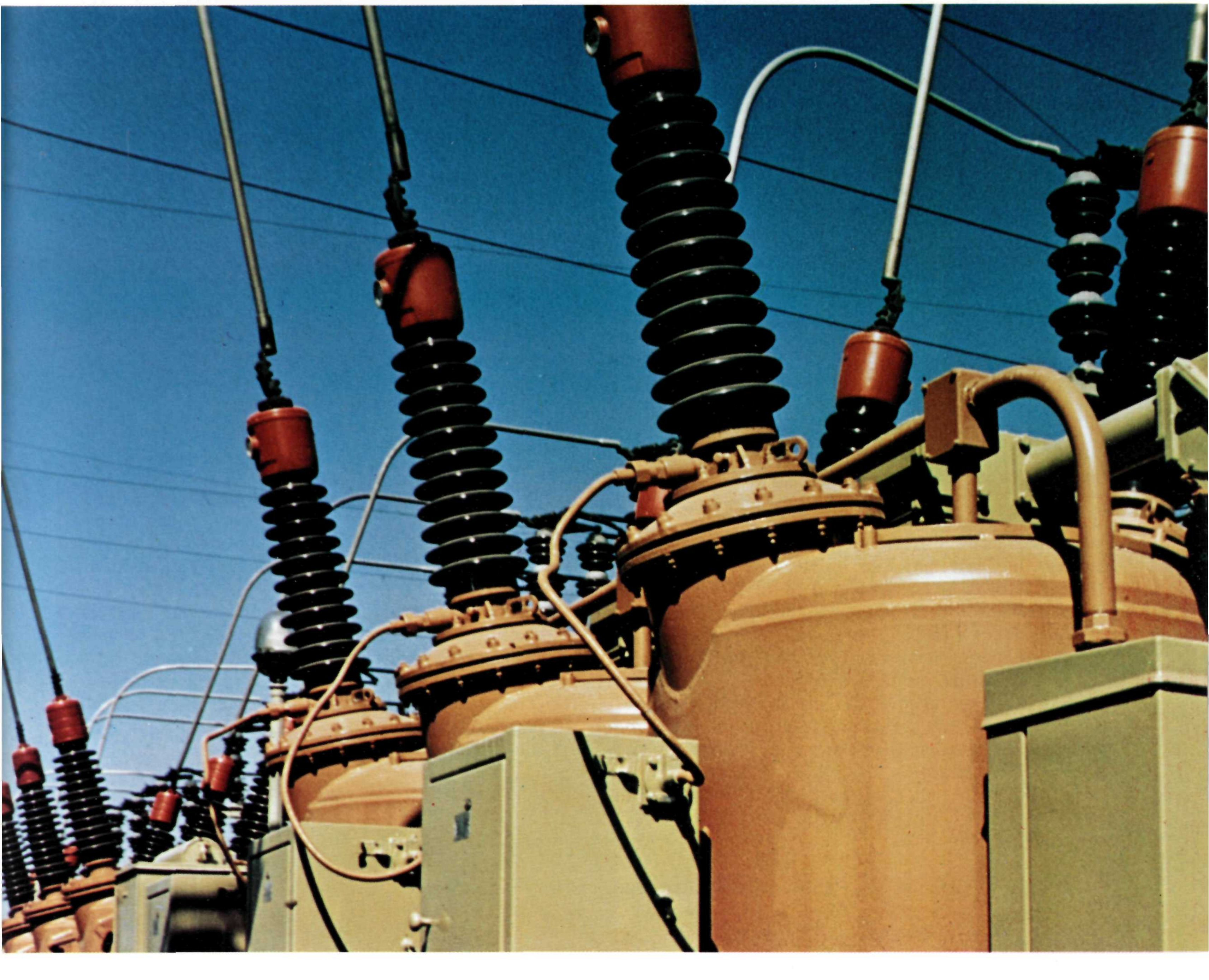
The Swan Valley-Teton line is only one of a long list of projects where Bonneville is stressing aesthetics. At Kalispell, Mont., on the main highway west from Glacier Park, BPA's district office and maintenance crew settled early last summer into refurbished and rearranged quarters. Gone forever are the nondescript maintenance and operations buildings that offended the tourist's eye. Near Pasco, Wash., Eugene, Ore., and Vancouver, Wash., at spots where appearance is important, concrete poles are being used to add more grace and beauty than would be feasible with wood poles.

Control houses with clean, modern facades are up or are being built up at four major Pacific Northwest substations: Lane, Wauna, John Day, in Oregon, and Custer, in Washington. A new-type substation with a low profile has been completed at Freewater, Ore., and three more are underway at Pine Hollow, in Oregon, and Omak and Coulee City, in Washington. Substation sites are being landscaped and improved at more than a score of additional locations. BPA has 284 substations, and many now are wearing new colors—one shade for transformers, another for circuit breakers, and still another for the lattice steel overhead.





Combining beauty with utility, the Bonneville Power Administration came up with "beautility." New transmission tower designs are seen at left and right, above. The handsome facade at Kalispell, Montana, (center) masks area full of maintenance litter. Below, pleasant paint dresses up a substation.



Growth and Beauty Hand in Hand

The emphasis on appearance comes at a key time in Bonneville's development, for BPA is in the midst of its biggest building program. Its transmission system must grow. This is the situation on the U. S. Columbia River Power System: . . . Eight Federal dams and a third powerhouse at the Grand Coulee Dam are under construction. John Day Dam is nearly complete, and others are well along. . . . The construction of three Canadian storage projects is on or ahead of schedule. . . . Generators must be added at Chief Joseph and other Federal dams to use water released upstream by the Canadian dams. . . . One line of the Pacific Intertie is carrying power, and two more big lines are taking shape. . . . The Hanford generating plant, largest nuclear plant in the nation, is reaching its peak output. . . . Customer loads are growing steadily. Industrial sales have boomed.

Power must be moved to load centers as the new dams go into operation. Facilities serving customers must expand. And BPA's main grid, which provides backbone transmission for the Pacific Northwest, must be strengthened with more lines for the 500,000-volt overlay grid.

In 1967, BPA had nearly $100 million worth of construction in progress, with more to come. In fiscal 1968 those projects underway or started during the year will include 534 miles of 750-kv lines, 2,040 miles of 500-kv line, 16 miles of 345-kv, 527 miles of 230-kv, and 37 substations. The new starts in 1968 will include 816 miles of 500-kv line and 14 substations.

Some of the most impressive progress in 1967 took place on the Intertie. Grizzly and Malin substations, in Oregon, moved into the finishing stages, and the first alternating current line was energized at 500,000 volts. The second a.c. line will be energized in 1968.

During the last half of 1967 the first direct current line through Oregon and the converter terminal near The Dalles, Ore., began to rise above ground level. The d.c. line will carry 750,000 volts and will run to Los Angeles. It will be the nation's first big d.c. line and the world's longest. The line will be operated at half power beginning in April 1969, and will go to full power later that year. The fourth line, a 750-kv d.c. line to Hoover Dam is to be completed in 1972, a year later than planned.

In British Columbia, work has been completed a year ahead of schedule on Duncan Dam on Duncan River, a tributary of the Columbia. The reservoir behind Duncan was filled slowly in the summer of 1967, as the earthfill dam settled, and releases of the stored water began boosting generation at downstream plants in the United States.

Two other British Columbia dams are to be completed—Arrow, by April 1, 1969, and Mica, by 1973. Meanwhile, Libby Dam on the Kootenai River in Montana also is under construction.

The four Treaty dams—Duncan, Arrow, Mica, and Libby—will safeguard the Columbia River from floods at least as large as any in recorded history, and will almost complete the job of harnessing the power on the river's mainstem. Only one site remains where it would be feasible to construct a large hydroelectric project. It is known as Ben Franklin and is in Southeastern Washington between McNary and Priest Rapids Dams.

As the Treaty projects, Intertie, and 500-kv grid begin delivering more and more power, BPA's operations will become increasingly complex. To maintain reliable service BPA must automate its control system further.

New techniques will be used to manage more effectively the flow of the Columbia River. Loads and resources will be estimated on an hourly basis, so any surplus power can be sent to the Southwest or power imported when needed. Huge amounts of electricity will flow in and out of the Northwest. Computers will be linked to highly reliable communications channels. The channels will collect vast quantities of data on such things as streamflows, the weather and power requirements; this information will be fed to central and area computers. Instantaneous decisions will be flashed to distant points so the greatest use and highest return may be obtained from the power system.

The automated control center with its computers will forecast loads, schedule generation, exchange information with other utilities, dispatch power, open and close switches, and even make marketing decisions involving millions of dollars. The computers also will be programmed to adjust power flows during emergencies.

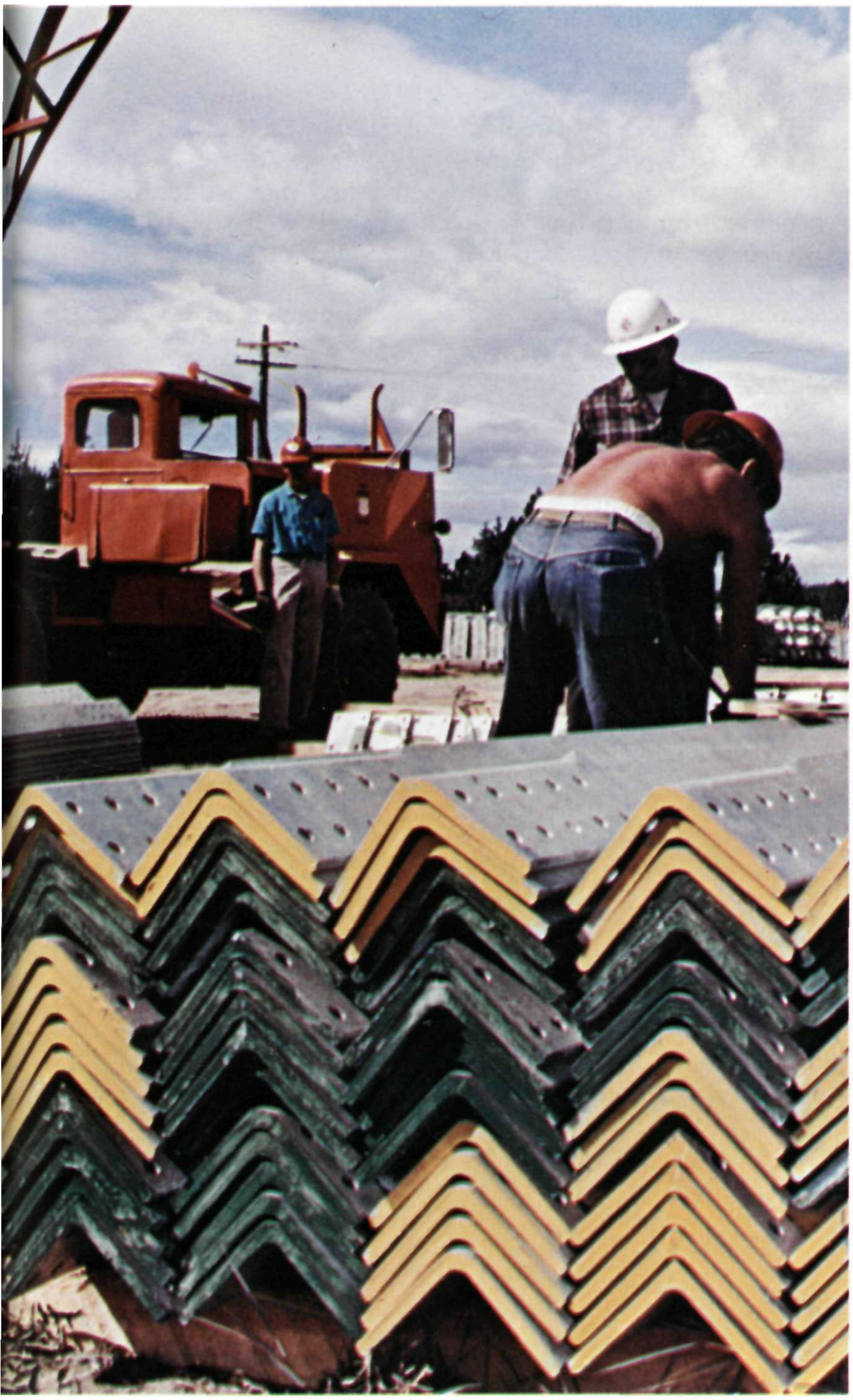
The human eye and the human hand can no longer be depended on always to respond quickly enough. The grid will soon be too big, too complex, and the consequences of mistakes too serious to use present methods of control. Humans simply do not have the ability to receive information, digest it, and reach decisions within time limits the transmission system can tolerate.

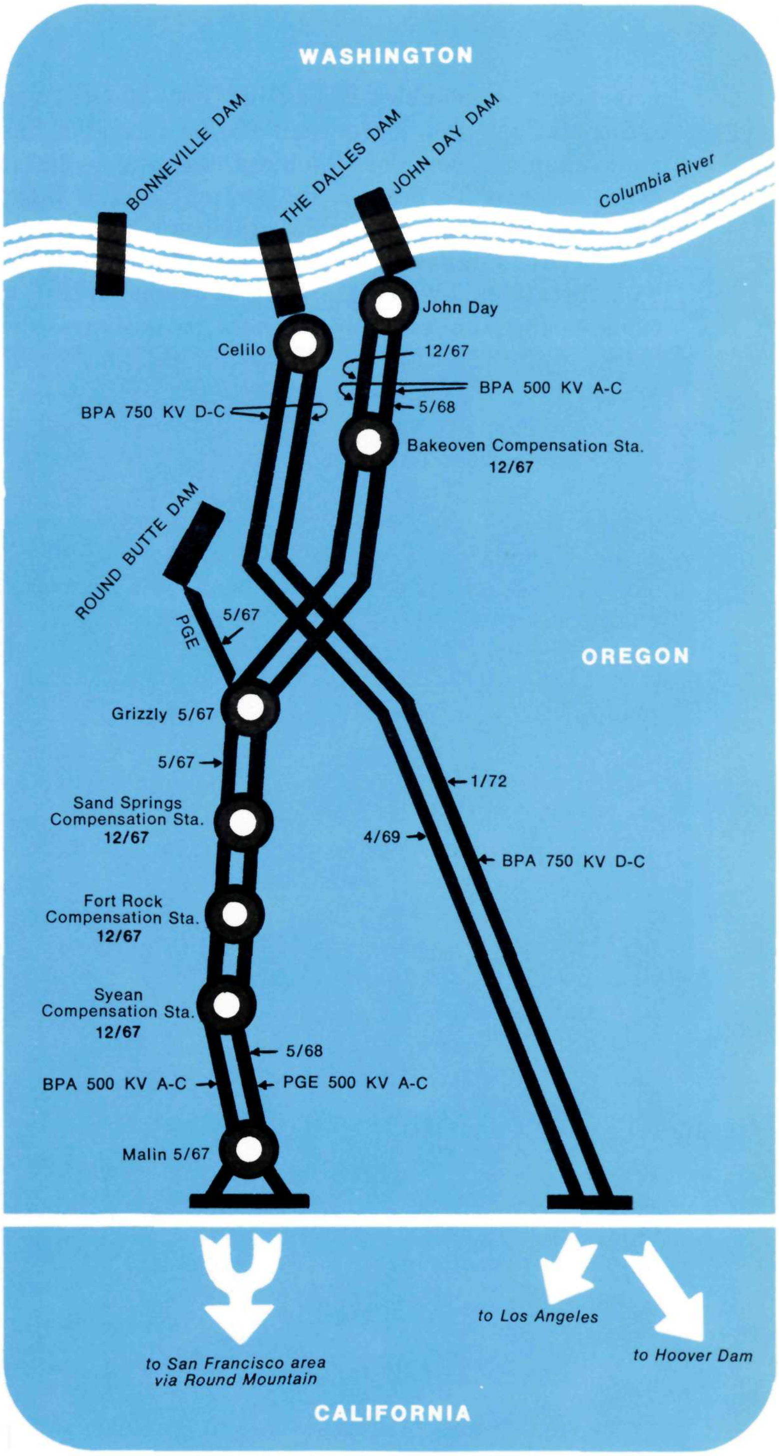
The control system already is semi-automatic. It has evolved from crude beginnings when the central dispatcher simply telephoned an operator at a substation and held the line while the man walked to the switchyard and threw a switch.

Today it is more than a communications network. Electronic impulses flash across it. Control devices sense changing conditions and give the dispatchers the long arm they need to reach out across the system and respond. Impulses routinely operate relays and switches, locate faults, and even measure the thickness of ice on lines at remote points.

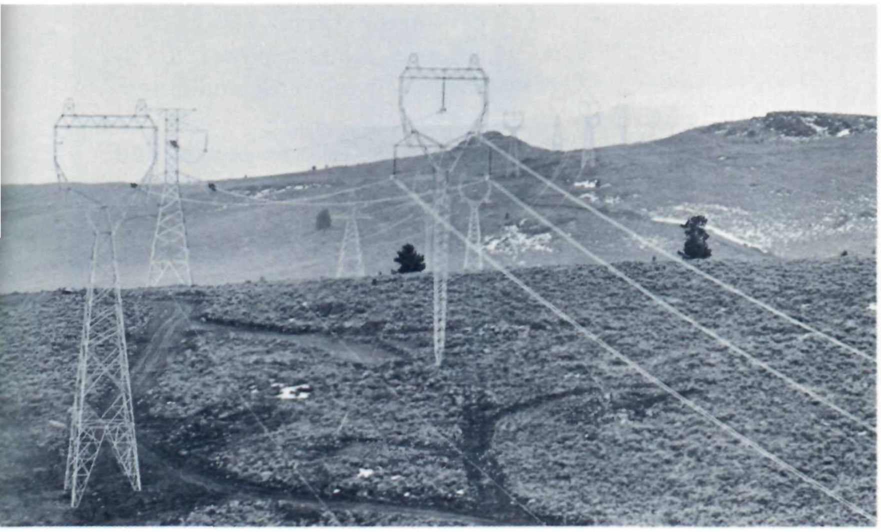
World's Largest Transmission Network

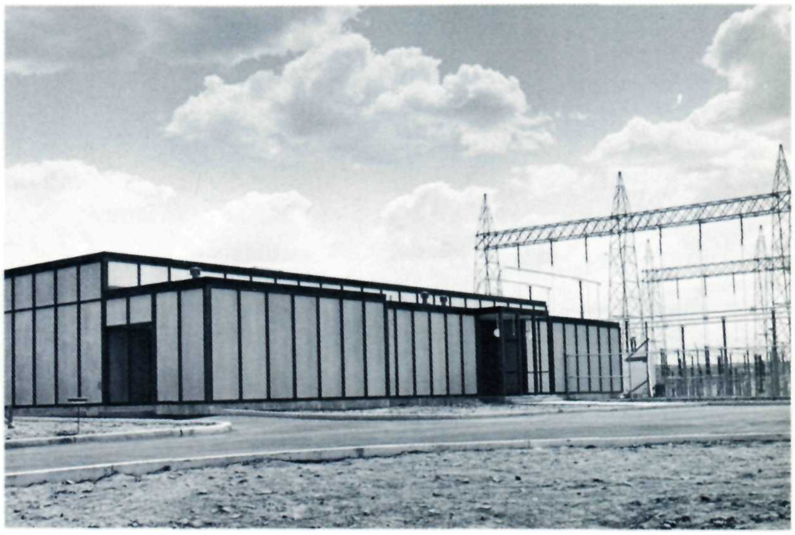
The BPA system now has nearly 10,000 circuit miles on what is the world's largest network of long-distance, high-voltage transmission lines. The control system is an integral part of the transmission grid, and its chan-





The construction yard at Bend, Oregon (left) is stacked with material for the world's largest network of long distance, high voltage transmission lines—the Intertie (right). Below, 500,000-volt lines (left) and the John Day Substation, both in Oregon, get ready to perform their Intertie duties.





nels *must* be reliable. Bonneville has 56 micro-wave radio stations and more than 65,000 circuit miles of audio channels, some of which can carry up to 600 messages at once. To operate its portions of the Intertie, BPA is installing 22 radio stations equipped with 38,600 circuit miles of control channels. BPA operates 45 substations by remote control from central locations, using the control channels to activate circuit breakers, control voltages, and meter the flow of power at stations miles away.

The biggest problem facing Bonneville and the utilities who serve the region's 5.5 million persons is the transition to thermal power. For the past 30 years the region has enjoyed the benefits of low-cost power from hydro plants, many of them large Federal projects. The Northwest, however, soon will run out of sites where it is feasible to build new dams, and it must then construct steam plants to generate electricity. How well the utility industry accomplishes the change from an all-hydro system to one that uses hydro for peaking and steam for the base load will determine how much of the advantage of low-cost power the Northwest will retain.

Bonneville does not see itself as the builder of the steam plants, but it will be called on to provide reserves, peaking capacity, and transmission. In return it expects to acquire energy from those who build the thermal plants. The first of these plants probably will use coal for heat. Those that follow will use nuclear fuel, for the atomic generating plants are proving to be clean, safe, reliable, and economical.

BPA is now working closely with the utilities' joint thermal power planning group to assure that these plants will be of a size that will produce power cheaply, that they will be well located from the standpoint of environment and costs, and that they will come into operation in an orderly manner that will avoid costly surpluses or deficits of power.

Southeastern Power

The Southeastern Power Administration (SEPA) marketed power during the year from 14 Corps of Engineer's projects to 88 rural electric cooperatives, 64 municipalities, 1 state agency, 5 privately owned power cooperatives, and the Tennessee Valley Authority. These customers, widely dispersed throughout the Southeast, are in Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Tennessee, and Kentucky. During the year, contracts were written providing for future delivery of power to generation and transmission cooperatives in Indiana and Illinois.

SEPA's annual revenues of approximately $29.3 million came from the sale of electric power from plants having a total installed capacity of 1.8 million kilowatts.

Additional Corps' projects soon to be in operation, including the Percy Priest Project in Tennessee, the Millers Ferry Project in Alabama, and the Carters Project in Georgia, are expected to increase materially the number of customers served by SEPA and to expand its operating area.

During the year a rate reduction was made for power from the Jim Woodruff Project, which is delivered to several cooperatives and municipalities in Florida.

Southwestern Power

The service area of Southwestern Power Administration (SWPA) comprises all or portions of Oklahoma, Arkansas, Missouri, Kansas, Texas, and Louisiana—an area of about 400,000 square miles. The tremendous population and industrial growth of this region calls for bold planning, careful resource development, and an overall sense of conservancy.

One such accomplishment in which SWPA has been a moving force is the authorization of 23 Federal multiple-purpose hydroelectric reservoir projects in the Arkansas, White Red, Brazos, Neches, and Osage River Basins of the SWPA operating area. These reservoir projects and the hydroelectric power and energy generated by them have an immense impact on the development and conservation of the natural resources of the Southwest. Almost 40 per cent of the $1.5 billion total cost of these 23 projects will be repaid through the sale of power by SWPA.

During Fiscal 1967, SWPA energy sales totaled 3 billion kilowatt-hours compared to 2.6 billion in Fiscal 1966, an increase of 13 per cent. Gross revenues for Fiscal 1967 totaled nearly $29 million, compared with $27.2 million for the previous fiscal period, a 6 per cent increase. In Fiscal 1967, 43 percent of the energy marketed by SWPA was sold to REA Cooperatives, 14 per cent to municipalities, 5 per cent to public authorities, 12 per cent to aluminum industry, and 26 per cent to private utility companies.

SWPA operates 1,443 circuit miles of interconnected high-voltage transmission lines and 32 substations and switching stations.

Alaska Power

The Alaska Power Administration, with headquarters at Juneau, was established June 16, 1967. It has broad responsibilities for planning, administering, and operating federal power developments in Alaska and will advance, in cooperation with Alaska power agencies and interests, proposals for developing and interconnecting new power sources.

APA also will continue the overall water, power, and related resource development planning started in Alaska by the Bureau of Reclamation. APA now operates the Eklutna Project and transmission system which supplies 30,000 kilowatts to Anchorage and outlying districts. It is cooperating with the Corps of Engineers in the planning and construction of the 48,000-kilowatt Snettisham Power Project which will deliver electricity to the Juneau area.

MINERAL AND FUEL RESOURCES

4

Photo by Clark Oil and Refining Corporation

Crude oil before refining.

MAN . . . an endangered species?

> *"Man has lost the capacity to foresee and to forestall. He will end by destroying the earth."*
>
> —Albert Schweitzer

Bureau of Mines

Modern man's use of minerals illustrates both his inventiveness and his lack of foresight. The technology of mining, processing, and using minerals has advanced rapidly, providing energy and materials in such abundance that, for the first time in history, a majority of the population enjoys a measure of affluence.

But while technology was giving, it also was taking away. Methods that gave access to essential minerals and fuels also damaged man's environment. Giant machines that permit economies in surface mining also scar the land and leave sores of eroded soil and polluted streams. Increasingly productive mineral processing plants often yield ugly mountains of refuse as byproducts. Advancing technology has squeezed more and more energy out of coal and oil but too seldom has that technology provided ways to reduce the air pollutants generated in burning these fuels.

If man is now an endangered species, the danger comes mainly from man himself. Pogo, the comic strip possum, summed it up: "We have met the enemy, and they are us."

Paradoxically, it is the successes of technology that make its failures apparent; our material abundance has given us the leisure in which to grow dissatisfied.

More than a hundred years ago at Walden Pond, Henry David Thoreau concluded that the essentials of life could all be reduced to one: keeping warm. Shelter and fire keep one warm in cold weather. Clothing conserves body heat. Food is mainly fuel to stoke the body's internal furnace.

Thoreau lived as independently as possible, in a cabin built of salvaged materials. He grew much of his own food. His mineral needs were the simplest: iron for his axe and other tools, glass for the cabin windows, sulfur matches, and ink made with carbon black.

Few modern men could live as simply even if they wanted to. Nevertheless, Thoreau's analysis holds true even for the man who rides to the office by subway, buys his food in a supermarket, and gets his power and fuel from a public utility. Keeping warm is still a basic thing. And the food, clothing, fuel, and shelter that keep modern men warm depend upon mineral resources.

All the mineral resources that ever will exist are here today: in air, water, and the earth itself. There is no way to add to what has been given. Man cannot create metals; he can only find them where natural processes have concentrated them.

Like the metallic ores that were formed by slow geologic forces, the fossil fuels, coal, oil, and gas, represent solar energy stored by plants over eons of time.

Our resources of fuels and minerals are being dissipated much faster than they were built up, and the rate of dissipation is accelerating. In the past 30 years we have used more coal and oil than in all previous

Photo by Roger L. Williams

Rippers and strippers tear the coal out of our suffering earth, thus serving the function of "keeping man warm." But where are the teeth in technology when it comes to restoring the land?

Photo by James A. Curry

history. It will take less than 20 years to do it again.

The natural checks of ecology make most life forms use their resources conservatively. A species will develop a balance with its food supply and maintain that balance indefinitely. The energy to support this ecological status quo comes day-by-day, from the sun.

But modern man is an ecological freak; instead of living on the "interest" from his natural bank account, he has found it necessary to spend capital.

Some time in the future, science may devise ways to create new capital stores of energy and materials. But for now we must expend the resources that we have to survive. Spending this capital wisely is conservation.

That kind of conservation has always been a prime objective of the Bureau of Mines. Since it was founded in 1910, the Bureau has worked to promote wisdom and efficiency in the extraction, processing, and use of metals; non-metallic minerals like potash, sulfur, sand, clay, and stone; and the fossil fuels.

Our Double Dilemma

Today, the Bureau and the Nation face a double dilemma. Today, when our requirements for minerals and fuels are higher than ever, we find that the easily obtained rich deposits of these essential materials have been depleted.

We must somehow extend our mineral resource base—the known and usable supplies—by developing new and markedly improved technology. We must find and develop additional sources of minerals that have thus far remained untapped. More efficient mining methods can make low-grade deposits workable. Better processing techniques can make available more of the mineral values inherent in these deposits. Improved utilization can do the same, and also make our resources serve us longer.

But—and this is the challenge that must be met if man is to survive and advance—these essential tasks must be accomplished economically within a context that permits no further contamination or degradation of our environment.

There are several practical ways in which the known and available supply of minerals can be increased.

The earth's crust has not been fully explored; hence, new supplies can be discovered. And resources that are marginal can become useful when the right technology is developed.

One of our most urgent needs is for methods and equipment that will enable us to push far deeper into the earth for minerals. This source is yet unevaluated because it is beyond our reach. To probe it, and to work whatever mineral deposits it holds, will require whole new mining systems.

A primary need is for a means of rapid excavation . . . tunneling through the earth's varying strata with a safety, speed, and efficiency far beyond anything now known. New techniques for breaking rock, hauling materials, supporting tunnel roofs and walls, and controlling the total underground environment must be woven into flexible and economic excavation systems. Underground mining must, in other words, be converted from a series of separate operations into a single, continuous process. Only in this way can man hope to tap the potential sources of minerals that now elude his grasp.

For several years the Bureau has been working to develop such revolutionary technology. Now others are realizing that rapid excavation systems could benefit many areas besides mining. In a nation looking constantly for additional space, such systems could provide it. Subsurface transit facilities, storage areas, and tunnels for transmitting power, transporting water, and disposing of wastes would clearly become more practical.

Widespread interest in such applications recently culminated in a Government contract to the National Research Council for a study to identify areas where rapid-excavation research should be concentrated. Because of its knowledge and competence, the Bureau of Mines was selected as prime contractor by eight other federal agencies supporting the Council's study.

Work is also underway to develop further the mineral potential in the three-fourths of the earth's crust that has never even been surveyed: the part lying under the oceans. The Bureau's newest and largest ocean-mining-research vessel, the *Virginia City*, left its home port of Tiburon, Calif., early last summer on a major scientific mission. In the waters of the continental shelf off Alaska, Oregon, and California, scientists and engineers on the *Virginia City* began sampling undersea sediments and rocks for deposits of the so-called heavy metals, such as gold, silver, mercury, and tin. All of these, and others, are in short supply. Past erosion washed heavy metals from their native rocks and concentrated them in "placer" deposits. There is strong evidence that forgotten river courses now buried under ocean silt contain such placers and that these placers can be mined.

The immediate objective is to devise reliable methods for sampling these undersea placers so the economic potential needed to spur commercial development of the deposits be defined.

Getting More from Marginal Resources

Simultaneously more precise techniques are being sought for sampling mineral deposits on land. The problem is to find methods that can determine accurately and at reasonable cost whether it will be profitable to mine and process low-grade ores. A deposit containing only one part of metal to every million parts of rock might be developed commercially if the metal happens to be gold, and if relatively few samples are needed to learn just where the gold is concentrated.

More efficient sampling is one way to get more out of mineral resources that are marginal. Improved processing is another way; and here too the Bureau of Mines is working to extend technology. In metallurgical research, one of the year's most promising developments was the start of a cooperative pilot test with industry, using a new Bureau process to recover uranium from solutions that leach copper from a large low-grade deposit. New sources of uranium are important to a nation anticipating increased use of this metal, but the uranium in these solutions had until now been lost.

In still another approach to better technology, the Bureau joined the Atomic Energy Commission and the El Paso Natural Gas Company in preparing for Project Gasbuggy. Agreement to proceed with the experiment, in which a nuclear explosive will be detonated deep underground in a low-permeability natural gas formation, was reached early in 1967, and the detonation itself was tentatively scheduled for fall of the same year. The explosion is designed to fracture part of the gas-bearing Pictured Cliffs formation in New Mexico, thus permitting as much as a sevenfold increase in the volume of gas that can be recovered economically.

Minerals from Wastes

Perhaps the greatest challenge of all to man's ingenuity, and a large part of the solution to his double dilemma, lies in the recovery of mineral values from waste.

In a typical year, for example, the unburned residues from this country's municipal incinerators contain more than 6 billion pounds of iron and 400 million pounds of aluminum, copper, zinc, and other nonferrous metals. Incinerator residues, often richer than many workable ores, are plowed into the ground at dumps and landfills across the country.

Working with residues from a Maryland incinerator, the Bureau is after economical ways to recover and reuse these discarded metals. Sampling and separation methods have been explored in the laboratory, and work is continuing on the feasibility of scaled-up operations.

Wrecked or wornout automobiles are another great potential source of metal for recycling and reuse. The Bureau has taken the lead in investigating the scrap-auto situation, and last year it published a comprehensive analysis of the problem, identifying factors that impede the recycling of such scrap in 54 different domestic marketing areas.

At various research centers Bureau scientists are improving methods for separating the nonferrous metals in auto hulks from the ferrous ones. The Bureau is also scaling up its method for using steel scrap, from autos and household appliances to treat abundant domestic iron ores that have so far remained unused because they cannot be concentrated economically with conventional methods.

Demonstration of the Bureau's method can yield a twofold benefit: a new market for a waste material and a large new domestic source of indispensable iron ore.

The same kind of double benefit is being sought in many other solid-waste projects conducted by the Bureau. In some, the objective is to recover ceramic materials from "red mud" wastes of alumina plants. In others, it is to make structural materials from mine and mill residues. The constant aim is to convert obnoxious and dangerous wastes into materials that will serve mankind.

As part of this same program, the Bureau in recent months awarded over half a million dollars in contracts and grants to universities and other organizations for research on utilizing mineral wastes. Such financial support also provides training for young scientists and engineers in disciplines that will be urgently needed in the future. Under each grant, senior research workers guide the efforts of students, training them in talent-short fields of science and engineering.

The Cost of Carelessness

Our past carelessness in disposing of solid waste from mineral operations now haunts us widely and with a vengeance. In many areas manmade mountains of debris encroach on cities and occupy land that could be put to better use for industry, housing, forestation and recreation.

The anthracite region of Pennsylvania alone contains almost a billion cubic yards of coal mine refuse. Coal in these waste piles and also in abandoned mines can catch fire and burn for years, polluting the air for miles. There, and elsewhere, the "overburden" of earth and rock removed to expose mineral deposits for surface mining, and the residues from mineral processing, has created problems that are literally mountainous.

Just to get at what we need, we move mountains of earth and rock every year: three billion tons in extracting coal and more than that in mining other minerals.

It is now generally recognized as good surface mining practice to replace the overburden and then to grade and plant the disturbed area to restore its value as real estate. Unfortunately, such exemplary practice has not been the rule in the past.

The damage our lands have suffered from surface mining became a subject of national concern when Congress—in the Appalachian Regional Development Act of 1965—directed the Secretary of the Interior to evaluate the nationwide effects of such mining and to recommend any corrective action he considered necessary.

Secretary Udall's report, published in mid-1967 drew on the expertise of several Interior bureaus and half a dozen other federal agencies. At his request, liaison officers were appointed by the various states to work with the federal task force. Municipalities, industry, and citizens' groups also participated.

Every State Affected

In the wide-ranging study, it was found that every state has been affected by surface mining. More than

3 million acres, an area as big as Connecticut, have been disturbed and though attempts at reclamation have been made, over 2 million acres—equivalent to a State of Delaware—still urgently require restoration work, just to preserve water quality in the streams and rivers that drain them.

It was learned also that less than one-third of the land that is surface mined each year is being properly reclaimed. At this rate, the inventory of damaged land will total five million acres, roughly the size of New Jersey, by 1980.

Federal standards for surface mining and land restoration were proposed by Secretary Udall as guidelines within which each state can establish adequate controls. Most important, a complex and serious national problem has been clearly defined, and a way to resolve it pointed out.

Meanwhile, the Bureau of Mines, which had coordinated the surfrace-mining study for the Department, continued to battle the damaging side effects of past coal mining operations, both surface and underground.

During fiscal 1967, 12 fires in abandoned coal mines were attacked in cooperative state-federal control projects with an estimated cost of nearly $11.5 million. By year's end, 3 fires had been controlled. The other 9 projects, including 2 designed to subdue large and dangerous fires near Scranton and Wilkes-Barre, Pa., were still under way. Completion of all these projects will benefit more than 300,000 people in northeastern Pennsylvania and protect private and public property valued at nearly $650 million.

Other projects conducted cooperativley by the Bureau and the Commonwealth included 2 aimed at reclaiming lands surface-mined for coal and 3 designed to combat subsidence over old mine workings. The latter, with an estimated cost of $2.3 million, will benefit more than 14,000 people and protect property valued at approximately $38 million.

The disposal of mine and mill refuse also is a mountain-size problem. Solid wastes from extractive and processing operations can be noxious as well as ugly. They may be rich in pyrites, as some coal mine wastes are, and form acid waters that pollute streams and rivers. Or they may contribute choking clouds of dust to any wind that blows.

Bureau efforts to cope with such wastes take many forms. Ways are being sought, for example, to make plants grow on waste piles, much as dune grass is planted at seashores, to increase their resistance to the erosive action of wind and water. In other experiments, the Bureau is aiming at greater efficiency in pumping waste back into empty mine passages. Such practice gets rid of the waste and helps prevent the ground above from caving in.

The Bureau's concern with underground safety and its work on coal combustion long ago led it to pioneer in air-pollution research. As a result, outstanding competence was gained in detecting and controlling noxious substances in air. This experience now is being used increasingly on problems that have assumed major importance to the public.

Most coals and other fossil fuels contain sulfur which, when the fuels are burned, forms sulfur dioxide. This colorless pungent gas, corrosive and toxic even in relatively low concentrations, is a major contributor to air pollution.

An obvious way to eliminate sulfur dioxide would be to burn only fuels that contain little or no sulfur. Unfortunately such fuels are not readily available in the quantity required. There are methods, however, for removing the sulfur during or after combustion. One of the most promising, developed by the Bureau of Mines, uses pellets of alkalized alumina to absorb sulfur from combustion gases before the gases reach the atmosphere. Sale of the recovered sulfur can help pay the costs of cleaning the combustion gases.

Continued testing of the Bureau's process on a pilot scale has thus far revealed no insurmountable technical barriers to commercial-scale application. Meanwhile, recent Bureau experiments indicated potential application for the process in cleaning smelter stack gases, which carry some 7 billion pounds of sulfur dioxide into the atmosphere each year.

Values Thrown Away

Also generated by industrial furnaces is "fly-ash," a gray powdery residue of unburned minerals. Most fuel-burning industries long ago installed collectors to remove this troublesome waste from their stack gases. But once it is collected—in volumes totaling some 20 million tons annually—it then must be disposed of. Simply to do this costs industry between 50 cents and $2 per ton.

Research by Bureau experts and others has shown that what industry is now paying to throw away is actually a valuable material. Fly-ash can be used to strengthen cement, concrete block, and brick. It also is a good soil stabilizer and filler for asphalt paving. Add to these properties the fact that potentially recoverable quantities of such rare and high-priced metals as beryllium and germanium are often concentrated on the surfaces of fly-ash particles, and the logic in its costly disposal becomes even more questionable.

Curbing the loss of still other values, in this case energy values, is a continuing objective at Bartlesville, Okla., where Bureau scientists are performing intensive research on automotive exhausts. Unburned hydrocarbons equivalent to 10 percent of the total gasoline consumed annually in this country are puffed from the tailpipes of our millions of automobiles. These hydrocarbons, along with other exhaust-gas components, react with sunlight and air to form pollutants that can endanger most life forms.

The work at Bartlesville is designed to yield the basic knowledge required for efficient control of automotive exhausts. Some of the knowledge already obtained is now being used by Bureau engineers who are working to develop a prototype anti-smog automobile — one with pollutant-controlling mechanisms that can significantly reduce auto-exhaust emissions.

These are some of the ways in which the Department's Bureau of Mines is working to assure both a continuing supply of minerals and fuels and a quality environment for the American people. These two goals, despite the difficulties and unresolved conflicts they represent, are closely related. Both must be achieved if man is to survive and if that survival is to be meaningful.

Thoreau's Concepts Still Apply

"Keeping warm" is just as essential today as it was in Thoreau's time. We still require minerals and fuels in ever-increasing amounts to fill this basic need. But clean air, pure water, and space in which to live, walk, and occasionally be solitary are just as indispensable to our physical and intellectual growth as they were to his.

It is true, of course, that times and circumstances have changed. Life today is infinitely more complex, and often more confusing, than it was for one man in a cabin by a pond before the turn of the century. But fundamental truths stay with us and our belief in the value and purpose of life persists.

Man may, at this moment in history, be an endangered species, but he remains a highly resourceful one. His faith holds, as Thoreau's so obviously did, in the maxim: "The future is not in Fate's hands, but ours."

Office of Coal Research

Power plant managers showed great interest in a process being developed under an Office of Coal Research contract for making flyash into brick and other construction materials. A pilot plant for this process is under construction at Morgantown, W. Va., after successful bench-scale research, and was expected to start operation in the fall of 1967. By turning their large volumes of flyash into income instead of facing the expense of carting it away, power plants find economic incentive to install improved anti-pollution devices to capture the ash.

Other OCR projects to improve conventional power generation were underway and included corrosion reduction, development of a fluidized bed combustion system, and a thermionic topper for more efficient fuel utilization. Projects for entirely new methods of generating power free of air pollutants and requiring little or no water, included a fuel cell, electrogasdynamic (EGD) generation, and magnetohydrodynamic (MHD) generation.

OCR's program for power generation represents only one project classification. The others are for converting coal to liquid and gaseous fuels, for new coal uses, for mining and preparation, and for transportation and marketing.

OCR's conversion program includes processes for production of gasoline, pipeline quality gas, low-Btu

We can no longer afford a one-way ticket for our junk. Utility and beauty both demand a round trip.

gas, and crude oil. Some of these involve chemical coproducts. One project is developing a low-ash, low-sulfur coal through a process called solvation. Conversion of coal to synthetic fuels could extend the life of our oil and natural gas reserves.

Projects for other new uses include the use of pulverized coal as a filter in sewage treatment, and the processing of anthracite culm banks (now polluting the atmosphere) into potentially useful products.

Computer mining programs developed under an OCR contract already are in use by the coal industry, and this research has been extended. Lower mining costs can make conversion to liquids and gases economic at an earlier date. It also improves the economics of coal use for conventional purposes.

Studies for cutting coal transportation costs offer the same advantages as reduction in mining cost, and projects include transportation of coal destined for export (with incidental beneficial effects on balance of payments), and for selected domestic markets. (Converting coal to more transportable forms, liquids and gases, is an indirect means of reducing the transportation cost of coal.)

Coal research is the key to important conservation and related environmental problems, and the Office of Coal Research concentrates on areas where technological developments have lagged. Improved coal use, and new uses for coal at costs competitive with like products from other sources, can greatly expand the Nation's resource base, cut down on pollution of air and water, and help prevent future product shortages and increases in energy prices. It is sound conservation to meet part of the increasing demand for a wide variety of fuels by coal conversion, since coal reserves are available to meet needs for several hundred years. The OCR program is directed toward speeding up these technological gains by contracting with the Nation's leading research organizations, chiefly on the basis of unsolicited proposals.

Before an OCR project proceeds to the pilot plant stage, its prospects for commercial feasibility are evaluated. OCR's General Technical Advisory Committee, representing related business and professional expertise, also reviews it.

The first of these pilot plants (conversion of coal to gasoline) was dedicated in May 1967. Other pilot plants are under contract for design and construction.

Office of Minerals and Solid Fuels

Minerals and solid fuels are essential resources not only to the economy of the United States, but to man's ability to survive.

The Office of Minerals and Solid Fuels continued during the year to develop plans and programs to assure that there will be adequate supplies of these resources to meet necessary civilian and military requirements in an emergency, including a nuclear attack.

All the important minerals are not produced in the United States and some are not produced in sufficient quantities to meet normal requirements. Over the past years those minerals for which we rely on foreign sources or of which the United States does not have adequate reserves, have been acquired by the Government for standby emergency uses. The Office of Minerals and Solid Fuels has cooperated in the release of some of these materials, and in the development of incentive programs to increase production of scarce resources to meet the needs of the growing economy.

Office of Oil and Gas

The outbreak of war in the Middle East in June of 1967 and the interruption of the flow of oil to Western Europe that resulted were cogent reminders of the critical importance to modern industrial nations of adequate and secure sources of petroleum. Although less than 3 percent of U.S. total oil supply was affected, the interruption involved nearly half the oil supply of the free nations of Western Europe.

Since its formation in 1946 at the request of President Truman, the Office of Oil and Gas has concerned itself with insuring that the U.S. has enough oil and gas to meet its needs in peace or war. Over the several weeks immediately preceding the war in the Middle East, the Office of Oil and Gas worked steadily with other government agencies and with the petroleum industry to prepare for possible disruption of oil supplies that could weaken the collective security of the Free World.

When the need arose, the domestic petroleum industry was ready. Within three weeks after closing of the Suez Canal, U.S. producers had increased their oil shipments by half a million barrels a day—40 percent of it going to supply neighboring Canada and the nations of Western Europe. This prompt response was a tribute to the vigor and resiliency of the domestic oil industry.

Oil Import Administration

The Oil Import Control Program and the Oil Import Administration were established in 1959 for the purpose of insuring a stable, healthy oil industry in the United States, capable of exploring for and developing new domestic petroleum reserves to replace those being depleted. Basis of the program is the certified requirement of our national security to maintain a healthy, vigorous petroleum industry in the United States.

To insure attainment of this objective, Presidential Proclamation 3279, issued March 10, 1959, instituted an import control system designed to maintain the domestic capability to "seek and find" the required reserves.

The 1967 Mid-East oil crisis emphasized the necessity for adequate production capacity and reserves, the goal of the Oil Import Administration.

HUMAN RESOURCES 5

Photo by Wayne J. Stevenson

Our most precious resource.

MAN . . . an endangered species?

> *"Civilization has reached the point where the new frontier now lies in the mind itself. Americans must conquer knowledge as formerly they conquered the wilderness."*
>
> Admiral Hyman Rickover

Bureau of Indian Affairs

Less than a century ago the Indian—alone of all Americans—faced a very real threat of extinction, physical and cultural. War, famine, disease, and national indifference had left only ragged remnants of once powerful tribes and proud people. They lived in isolation and abject poverty, finding the strength for life in the reverence for land and nature that is the cultural core for most Indian society.

Today this special threat to the Indians' continued existence has ended. Indeed, an Indian population growing at a rate twice the national average and an increased Indian lifespan have created the opposite problem on many reservations. However, many Indians fear that the spiritual values and cultural concepts which sustained them when there was no other comfort or hope may collapse before an onrushing civilization which will not pause to understand their heritage.

The Bureau of Indian Affairs (BIA) is charged with the responsibility of helping the Indian preserve his priceless identity while at the same time helping him overcome the backward conditions that still characterize many Indian areas.

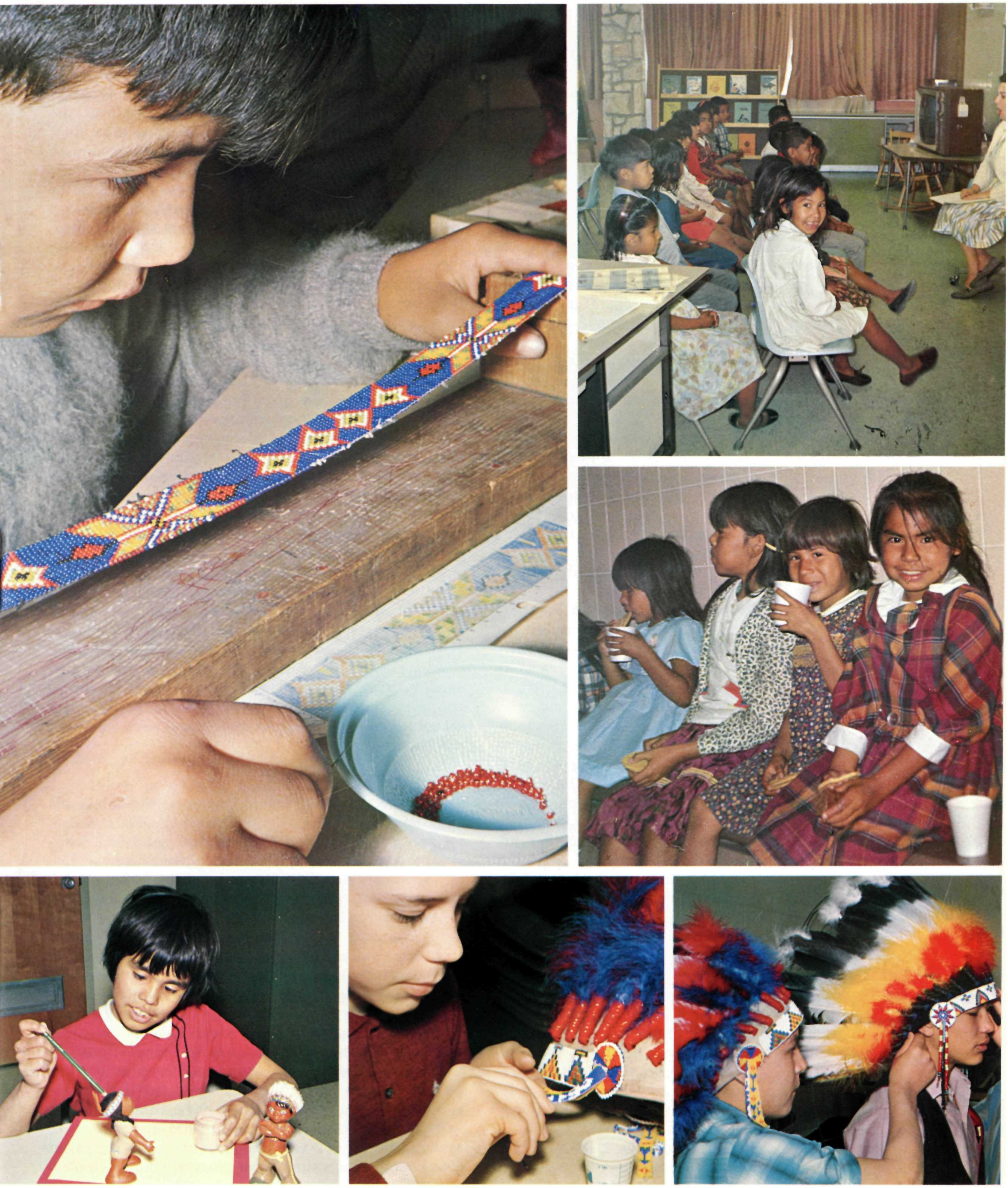
More than 425,000 Indians and Alaska Natives live on or near reservation Indian communities for which the Department of the Interior is trustee. These trust lands total approximately 50 million acres. Some of the property is extremely valuable and capable of extensive development. However, much of it is too dry, mountainous, or isolated to be capable of supporting adequately those who live on it. Similarly, some Indian communities are close to growing labor markets; others are isolated from commerce and industry.

Although its mandate to assist the Indian is based on trusteeship over his land, BIA focuses its programs on people, rather than land. BIA rejects the concept that it can function as the sole arbiter of Indian affairs. It seeks to eliminate the paternalism that has too often stifled initiative and to create, instead, an atmosphere in which the Indian—individually and collectively—assumes responsibility for charting his own future. He is encouraged to seek the assistance that best serves his needs from the wide variety of options that have been created within and outside government in recent years. The Bureau provides advice and counsel as needed.

New Paths Sought

BIA encourages Indian leadership to explore the assistance programs of other government agencies—the Departments of Labor; Health, Education, and Welfare; Housing and Urban Development, and the Office of Economic Opportunity—of state and local levels of government and of private sources, such as foundations and universities.

Indian problems tend to be subtle and complex and many of their solutions are controversial, but no one has contested the priority of education in the Indian



New and imaginative approaches are being explored by the Bureau of Indian Affairs in an all-out educational effort to break down the language barriers and cultural handicaps Indian children face.

development programs. All these programs require an increased participation by Indians whose decisions are based on an educated understanding of our society. Modern education is the key that unlocks society's commercial and scientific tool chest.

Understandably, then, the majority of the budget and staff of BIA works to improve Indian education. The aim is a quality school system adapted to the special challenge of educating Indian children. Recruitment of top educators is under way. New curriculums are being developed, pilot and demonstration projects are being financed, research is encouraged, teacher training for special services is being emphasized and the special needs of Indian children—from kindergarten through high school and beyond—are being examined.

During the past school year almost 54,000 children were enrolled in BIA day and boarding schools. In keeping with the Bureau's policy of encouraging Indian enrollment in public schools, a larger number—86,000—was enrolled in public schools in Indian areas. An estimated 30,000 additional Indian students attend public and private schools in states no longer in the Indian school census, since these states have assumed full responsibility for educating Indian children. Public school opportunities are expanding, but the BIA's school population continues to grow. School rooms for 3,378 new students were built and outdated facilities serving 1,100 more pupils were replaced.

The Bureau provided assistance, under the Johnson-O'Malley Act, for 55,406 Indian children enrolled last year in public schools. This Act is designed to help public schools meet the extra costs of programs to help Indian children overcome educational deficiencies and to compensate these schools for lack of tax revenue from Indian trust lands. Progress was made in pilot projects to identify and correct the problems which hinder the ability of Indian students to learn.

Central to the emphasis on education is the concept that school is a basic part of the Indian community. To insure school policies that reflect Indian ideas and desires, a 16-member National Indian Education Advisory Committee was created. Composed of tribal leaders representing areas with large numbers of Indian children in Federal schools, the Committee has worked to widen Indian participation in school affairs, both Bureau and public.

With the encouragement of the Bureau's Branch of Public School Relations, many more Indian parents are serving on public school boards of education and participating in parents' and teachers' organizations and programs. Last year, Bureau education officials met with tribal council members, Indian parents, public school officials, and students, to work toward eventual transfer of Federal schools to public school administration. Aim of the meetings was to build a base of mutual readiness.

The problems of Indian children are different, and a unique school system is needed to solve them. To that end, the Bureau's Division of Education established two new branches—Curriculum and Continuing Education, and Program Review—to keep the program closely attuned to Indian needs. An example of the programs being developed is that of "Teaching English as a Second Language" (TESL). Many Indian children come to school knowing only rudimentary English or none at all. The TESL program seeks, without downgrading the tribal language and the pride and identity its use connotes, to equip them with the basic language tool necessary for continuing education. Other programs make use of summer vacation time and the evening hours of boarding school pupils for the intensive education needed to put Indian pupils on a par with their contemporaries.

To determine how optimum applications of funds and new learning techniques would affect Indian education, BIA is taking part in an unusual experiment. It has turned over the new $3.5 million Rough Rock Navajo boarding school complex in Arizona to an educational corporation governed entirely by Navajo tribal members. With the Office of Economic Opportunity, the Bureau is financing this corporation which seeks better education not only in the narrower range of teaching youth but across the broad spectrum of the total community. The context is compatible with that community's life and Navajo tradition.

At Rough Rock many classes are conducted in Navajo. The tribe's best artisans teach traditional arts and crafts skills; the legends and lore of the tribe are part of the curriculum. Parents are encouraged to visit classes and dormitories; adult education classes are conducted at night. Teachers are encouraged to visit Navajo homes and to learn Navajo—one of the world's most difficult languages. All the school's facilities are open to anyone who wants to use them.

New Programs Funded

The development of new programs in Bureau schools received impetus in Fiscal 1967 from the $5.25 million for educational services to disadvantaged Indian children, a result of the "Indian Amendments" to the Elementary and Secondary Education Act of 1965. Major emphasis was on teaching English as a second language. Field trips gave children from isolated areas their first look at a restaurant, supermarket, industrial complex, and the many other features of our civilization that are commonplace to most children. Bilingual teacher aides, "parental" dormitory aides, additional library books, and more money for planning educational programs were other benefits resulting from the application of this Act to Indian education.

In spite of educational programs, the survival gap remains. Each year additional Indians find that muscle is not in demand, that the small farm cannot compete with the corporate enterprise, or that a machine has taken their jobs. When this part of the environment changes, the individual must change, too. Unemployment—sometimes running above 50 percent of the workforce—has been a constant problem in Indian areas and is made worse by the march of mechanization. To meet this problem the Bureau of Indian Affairs is combing a wide scope of endeavor and activity for new programs and ideas.

These programs help both the Indian who has decided to leave the reservation for improved opportunity and the one whose attachment to home and tradition is too strong to bear separation.

For those who want to resettle, the Bureau has a well-developed system of training and finding jobs for Indians. The existing system provides seven relocation centers in major cities where an Indian may train for a variety of occupations and then receive job placement assistance along with general counseling in the complexities of urban living. More than 10,000 Indians received direct employment, institutional, or on-the-job training benefits through these programs in Fiscal 1967 and a Labor Department-sponsored National Indian Manpower Conference, held in Kansas City, Mo., in February 1967, has developed plans to provide an additional $2 million in manpower training programs for Indians. These programs are aimed at the major Indian problem of unemployment.

But BIA also is launching some bold new programs that depart from existing concepts and may provide a major increase in effectiveness of Indian relocation.

One such program, run under contract with a private corporation, began April 1, 1967, on a deactivated Air Force Radar Base at Madera, Calif. Thirty families and 200 single men and women were brought together from several reservations into a "community" that exists to impart to them the skills, experience, and understanding that comprise personal qualification to survive in modern, urban America.

Life Adjustment Aids Provided

Potential wage earners—in many cases both husband and wife—receive help in all the elements that make a person employable: Basic education, specialized training, urban adjustment orientation, and job placement and follow-up. Family counseling, vocational counseling, pre-vocational and vocational training, and health services are among the provisions.

The trainee families, living in ranch-style two- and three-bedroom homes that formerly were quarters for service people, learn the routines necessary for successful urban living: Housekeeping, food purchasing, money management, and budgeting. They also learn trades, from auto-mechanics to drafting and from food service to secretarial skills. Children attend nearby public schools or a day-care center on the base.

With this intensive program the Bureau hopes to help these families make the difficult transition from one world to another in nine months to a year.

A transition of equal magnitude is the goal of another Bureau program at Philadelphia, Miss. Again under contract to a private corporation, a program has been developed for a group of third-generation tenant farmer Indians. These Mississippi Choctaw Indians have the following personal statistics: Average age of head of family, 28; average educational level for head of family, 1.6 years; average income, $450 a year. Through concentrated pre-vocational preparation, counseling in family living, close attention to the needs of the children, occupational training programs for adults, and a placement and follow-up service the Bureau seeks to free these people from the servitude of tenant-farming.

Other pilot programs are underway with Indian wage earners who have just been released from prison to prevent the additional handicap of a prison record from becoming yet another barrier between them and personal and occupational stability. Still other efforts are helping large Indian families, often the poorest and the least educated in the community, to meet the problems of providing an income sufficient for their needs.

These programs all help in the adjustment to environmental changes of varying severity. But for many Indians, who feel strong ties with the land or find irreplaceable identity in customs and habits that do not exist anywhere else, the environment must be modified to maintain Indian traditions while creating the potential for Indian economic self-sufficiency. The obvious way to do this is to develop Indian human and resource potential in the reservation setting.

Land Resources Worked

Indians are singular among the Nation's poor in that they have great land holdings. Comprising only .2 percent of the population, they own 2.16 percent of the land. In a variety of ways BIA helps make this land work for the Indian people. Excluding minerals, the gross income from natural resource production on Indian lands increased by more than $20 million in Fiscal 1967 to a total of $180 million. Mineral leases bring in another $30 million annually. More than 30,000 Indian operators now derive all or part of their livelihood from Indian-owned agricultural resources. Full use of Indian land potential could double this.

A better working relationship between Indians and the Department of Agriculture's Agricultural Stabilization and Soil Conservation Service has resulted in the outlay of $1 million more this year for ASCS services. Improved and expanded irrigation systems on Indian lands increased income last year by $8.8 million for a total gross income of $84.6 million.

An example of an unused resource put to work is the development of the rich Missouri River bottomlands owned by the Winnebago Tribe of Nebraska. The tribe did not have the financial ability to improve this land. So it entered into a five-year improvement lease with an area farmer, who cleared away worthless trees and brush, leveled the land, and installed drainage systems in return for use of the land. Improvements continued during the next five years with the farmer making additional cash rental payments. At the end of ten years the tribe was able to lease the land for five years at $25,000 a year. This represents new income developed without any expense to the tribe as well as a permanent increase in the value of tribal land holdings.

More than 12 million acres of Indian land is forested, and logging is becoming an increasingly important source of income for many tribes. Several tribes are moving from a policy of selling timber to outside firms for harvesting and processing, to tribal control of the entire operation.

In 1967, Secretary Udall approved a proposal by the Warm Spring (Ore.) Reservation Tribal Council to spend up to $15 million of tribal assets to develop a lumber and plywood processing complex, using reservation timber. The tribe anticipates creation of 250 jobs with a $1.5 million annual payroll for reservation residents and an annual income of $2 million for the tribe.

Forest Yield Increased

Total timber harvest in Indian areas reached approximately 850 million board feet in Fiscal 1967 and provided 6,000 jobs. The Bureau is urging a full allowable cut of one billion board feet a year, which would create an additional 1,000 permanent jobs with a new payroll of $5 million a year and would increase stumpage returns by $2.9 million annually. All Indian timber is managed and harvested under sustained yield principles for continuous forest production. Nearly 490 forest product-oriented businessmen rely to some extent on Indian forests in their operations.

Although many reservations are in remote areas and often have inadequate transportation and communications facilities, BIA has found a valuable industrial resource in the Indian people themselves. With their quick eye-hand coordination and their high tolerance for repetitive tasks, they constitute a valuable and useful resource for industrial development.

By the end of Fiscal 1967, more than 100 industrial and commercial enterprises, providing over 9,000 job opportunities, had been established in Indian country under the Bureau's Indian Industrial Development Program. This total includes 14 plants which, when they reach full operation, will each employ more than 100 Indians. The number of Indians employed in reservation plants now is up more than 800 over the beginning of this fiscal year and an additional 1,800 jobs will become available as the newer companies reach full operation.

Based on the Federal minimum wage—and a large number of Indian workers earn considerably more—payrolls in Indian country at the end of Fiscal 1967 were over $21 million on an annual basis for workers currently employed in reservation plants, with an additional $5 million anticipated as the companies approach capacity.

One unusual industrial development in an Indian area is formation of the Cape Flattery Company on the Washington coast Makah Reservation. This firm is

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Dying sunlight and brooding thunder squall paint Monument Valley, on Arizona-Utah border.

one of the first private ventures in the processing of fish protein concentrate, a product recently approved by the Food and Drug Administration for human consumption. The Indians, in addition to owning a part of the business through an investment of $50,000 of their own funds, will share in the plant employment and will operate a fleet of fishing vessels to provide the 200 tons of fish daily the company is expected to process.

Other examples of Indian industrial development are the new missile parts plant on the Navajo Reservation at Fort Defiance, Ariz., a clothing factory, largely manned by the Hopi Tribe of Arizona, and an electronic component plant on the Seminole Reservations in Florida. The tribes themselves have helped bring industry to their areas through demonstrations of tribal ability to provide the necessary work force and to share in development costs and risks by building the plants and leasing them to firms.

The Bureau also is assisting the tribes in working with programs developed by the Small Business Administration, the Office of Economic Opportunity, and the Economic Development Administration. For example, this integrated effort has produced 149 EDA program applications relating to Indian industrial development since EDA's inception in 1965. Of these applications, calling for nearly $45 million in Federal funds, 66, totaling more than $20 million, had been approved by the end of Fiscal 1967. Most of the approved applications—41 totaling $15 million—fall in the category of basic site facilities, such as the development of industrial parks, sewer, water, streets, and related installations which create an environment favorable for industrial development.

Those who have worked with Indian industrial development, share a conviction that increasing Indian awareness of the techniques of modern industrial progress and willingness of tribal leaders not only to use these methods, but to invest tribal assets, hard work, and initiative are key factors in the growing Indian industrial development.

Housing Gains Made

A highly visible sign of the poverty and lack of opportunity that too often characterize Indian reservations is inadequate housing. Indians are working, with Bureau assistance, in a variety of housing programs to meet the need for wholesale improvement.

Last year the number of conventional low-rent and mutual-help housing units completed or under construction increased by nearly 1,000 units to a total of approximately 2,300 units. These represent a development cost of around $13 million provided through financial assistance from the Housing Assistance Administration of the Department of Housing and Urban Development. Under the mutual-help concept, the Indian family contributes construction labor in lieu of the down payment. In addition to these programs, the Bureau's Housing Improvement Program provided new or improved housing for more than 200 Indian families who were unable to obtain such housing otherwise.

Under another program on the Rosebud Reservation in South Dakota, 375 low income families are abandoning shacks, tents and similar makeshift housing for new "transitional" homes. These homes, built under a cooperative program sponsored by the Tribe, OEO, HUD, the Public Health Service, and BIA, can be built at a rate of two a day through use of a central prefabricated plant.

The home are "utilitarian" by American suburban standards; most have no electricity or running water, although provisions to add both are built in. The 620-square-foot structures provide their owners with a warm and dry place to live and a new image of family life and self-respect that could be the first step toward a better and more productive life. In addition to meeting some of the reservation's most pressing housing needs, this program gives building trade training to the Indian who works at the prefabrication plant and on house assembly. The faith these Sioux have in the project is reflected in their name for it — "Anpo Wicharpi"—a Sioux phrase meaning "dawn of a new day."

While the Indian culture is receiving increasing emphasis in general Indian education, there is one Bureau facility which puts its *main* emphasis on Indian art and culture and Indian artists. This is the Institute of American Indian Arts at Santa Fe, N. M. Open to talented Indian students from across the Nation, the Institute provides instruction in a variety of artistic fields—painting, writing, photography, ceramics, dance and textiles, to name a few—as well as a general high school education. Theme of this endeavor is the culture and inspiration, as the individual student feels it, of his background and Indian identity. The Institute serves the dual purpose of maintaining Indian cultures and values, while training talented young Indians in occupations by which they may become economically self-sufficient.

The preservation of Indian arts and crafts and the techniques of creating them is also the function of the Arts and Crafts Board of the Department of the Interior. This Board encourages authentic arts and crafts production as a means of increasing Indian income. It works with many Indian groups in an effort to tailor output and selection to contemporary markets. The Board has helped establish standards by which authentic American Indian work can be distinguished from imitations.

The Bureau also works with Indians to develop more efficient local government. Members of the Bureau's Branch of Tribal Operations met during Fiscal 1967 with leaders from more than 40 tribes in a joint effort to make local Indian government more effective. This search for new governing tools reflects the growing determination of Indians to assume much greater responsibility for managing their own affairs. From these meetings have come totally revised tribal constitutions, amendments to update existing ones and, in some cases, recognition of organizations that previously had no formal structure.

The Branch has also worked closely with many tribal groups to develop tribal rolls so members of the various Indian tribes and communities may be better identified. This activity is in line with the Branch's responsibility to assist in disposing of the judgments awarded by the Indian Claims Commission. As of December 1966, a total of 88 tribes had been awarded well over $200 million for past inequities in land sales and treaty responsibilities by this independent tribunal created by Congress in 1946.

After an annual increase for several years, the number of Indians receiving Bureau assistance funds began to decline during Fiscal 1967. Anti-poverty activities on reservations and increased employment opportunities account for the decrease. The Bureau's Branch of Social Services helps Indian families deal with home environment problems that can interfere with the educational progress of children and the assumption of work and parental responsibilities. This Branch also works with the Division of Indian Health, Public Health Service, to give increased emphasis in providing family planning information and counseling to Indian women on reservations.

Indian cultures, with their strong group identity, their concept of man's unity with nature and their respect for individual dignity and worth can provide a valuable guiding ethic a nation seeking to re-create an evironment capable of sustaining and uplifting its citizens. The Bureau of Indian Affairs, and the Nation, are working to help the First Americans find for themselves a place of dignity and attainment in a better world for all Americans.

Office of Territories

GUAM—The Island of Guam contains 209 square miles of magnificent tropical scenery. The civilian population numbers close to 54,000 persons and is growing at 3 per cent per year. Guam's proximity to Asia makes it a highly strategic outpost for the United States, and military personnel are likely to hold at present levels.

While the island still has vast open panoramas, unspoiled natural features, and a relatively evenly paced way of life, the pressures generated by an increasing population are being felt. With an eye to preserving the island's environmental quality, a comprehensive master plan has been adopted, the recreation element of which was expanded and refined into a master recreation plan approved by the Bureau of Outdoor Recreation. Under this plan, five specific projects for preservation and development of regional recreation areas have been approved.

Guam was the only significant American possession to be captured and subjected to foreign rule during World War II. As a result of this experience, serious consideration is being given to development of a "War in the Pacific National Memorial Park." Furthermore, the lush tropical seashores, valleys, and mountains are being studied as a possible Guam National Seashore Park.

Programs in effect to upgrade living conditions on the island include urban renewal, public housing, zoning, subdivision control, building and housing codes, and sanitary codes.

As islanders living in an island society, Guamanians are more actutely aware of the absolute limitations of their natural resources than many a community of comparable size within the United States.

VIRGIN ISLANDS—Fully conscious of the possible threats to their natural environment, the Virgin Islands of the United States in fiscal 1967 created positive legislative programs to assure protection of their highly valuable water resources and to stymie pollution of their excellent natural harbors and magnificent beaches. Under an Act passed by the Virgin Islands Legislature, the insular Department of Health was declared the water Pollution Control Agency of the territory for establishing and administering water quality standards. The Department completed a study of coastal waters from which such standards are to be adopted. Also approved by the Legislature was a master sewage disposal plan for the Islands designed to eliminate sources of water pollution.

Throughout their history, the Islands have been plagued by limited fresh water sources. As pioneers in the use of desalted sea water, the Islands have had in operation for the past two years on St. Thomas two desalinization plants capable of converting a total of 1.3 million gallons of water daily. In fiscal 1967 ground was broken on the Island of St. Croix for construction of a 1-million-gallons-per-day desalting plant to supply that island.

The Virgin Islands have experienced a tremendous influx of new residents. Total population now stands at approximately 60,000, compared to the 1960 census of 32,099. A stepped-up housing program has been underway with new privately developed subdivisions mushrooming in the outlying areas of St. Thomas and St. Croix. The Government has encouraged proper development of these small suburban areas; results show well-planned and thoughtfully spaced housing complexes that enhance rather than detract from their natural surroundings.

With a rich cultural heritage that extends back to the days of Danish rule, the Islands have remained conscious of their historical sites, landmarks, and architectural patterns. Encouraged by both federal and insular government regulations designed to protect many of these man-made cultural resources, the Islands have intensified their own volunteer efforts to restore and preserve privately owned structures and buildings—in line with the nation's overall beautification program.

AMERICAN SAMOA—American Samoa, a tiny Polynesian paradise below the Equator, does not intend to duplicate the mistakes of the mainland. Its slogan is to plan and act now so that there will be no need to regret later. Total area of all seven islands is but 76 square miles. Of that, only about 25 per cent is habitable because of steep mountains rising from the sea.

Nobody on the islands assumes they will remain beautiful and unspoiled of their own accord. The Samoan Legislature this year passed a junk car bill designed to prevent the islands from being spoiled by unsightly, abandoned vehicles. Junked cars are collected periodically, and are dumped into the ocean where they again become useful by creating fishing grounds. Small fish seek shelter in car bodies. The small fish attract game fish.

American Samoa is off to a running start on its park program. A study team from the National Park Service recommended 12 sites for parks, one of which would be on the island of Manu'a, about 60 miles from Pago Pago. The Manu'a Park, not yet started, would be an area where life would go on much as it did a century ago. Meanwhile, dredged fill at the head of beautiful Pago Pago Harbor has provided the foundation for 24 acres of park for high-density use. Ultimately, this park, which commands a sweeping view of the bay, will have a spectator sports area, a typical Samoan village, and a children's playground and picnic area.

The chiefs of the village of Fagasa this year deeded to the government 43 acres of land for a permanent wilderness park. Primarily intended for weekend recreation use, it is heavily wooded and abounds with tropical flowers and plants. Samoa is cleaning its harbor of pollution and has under construction a sewage treatment plant. It is also acting to provide an adequate supply of good drinking water. Despite an annual rainfall of about 200 inches, fast runoff causes occasional water shortages. Nearly finished is the Vaipito Reservoir, which will hold about 3.5 million gallons and will serve the heavily populated bay area. The government also will share costs with villages to improve their water supplies.

TRUST TERRITORY OF THE PACIFIC ISLANDS—Most of the basic institutions and traditions of ancient Micronesia still exist in modified form, but the impact of the modern world, combined with rapid population growth, has been profound.

The limited land area of the more than 2,100 islands scattered across 3 million square miles of ocean has made it imperative that resources be preserved and economic and social development be carefully planned to improve living conditions, especially in the crowded urban district center islands of the Trust Territory. With the Territory's limited resources in mind, a comprehensive master plan is being devised to provide guidelines for specific uses of the limited land areas and their related foreshores. This master plan, while providing all the approaches to future development, at least offers a unified presentation which more or less definitely locates all presently anticipated capital development and other facilities requiring specific and locally interrelated space arrangements.

During the year, necessary pre-engineering surveys of the highly populated islands for power, water, and sewer development were made. Professional land-use planning is being programmed for each of the six district center islands.

Legislation establishing "conservation areas" in the Territory will be introduced at the next session of the Congress of Micronesia. Programs in health and education are being expanded and emphasis is being placed on improving community services in the congested, socially chaotic urban areas of the Territory.

For several years, community development programs have been endeavoring to stimulate local efforts towards better village health and living conditions. The U. S. Economic Opportunity Act has been used to augment these efforts. Community action agencies have been formed in all major population centers, broadening the popular base of self-improvement programs. These include plans for multi-purpose neighborhood centers, skills development, and Project Headstart for pre-schoolers. It is proposed in the future to link other programs such as Neighborhood Youth Corps, Upward Bound, and Job Corps to the community action projects.

At year's end, work had started on an extensive rehabilitation program in Palau, which was swept by a typhoon in March. Congress approved a supplemental appropriation of $1.7 million for restoration projects.

Job Corps Conservation Centers

The Jobs Corps Conservation Center Program was made possible by the Economic Opportunity Act of 1964.

Conservation Centers, with about 100-200 enrollees, are located chiefly on Federal lands and operated by Federal conservation agencies in cooperation with the Office of Economic Opportunity. Members of the Job Corps perform needed conservation work on the nation's forests, parks, and other natural resources. Working under supervision, they learn vocational and job skills, receiving basic education to improve abilities in reading, writing, arithmetic, and oral communication.

In addition, they receive guidance on how to apply for a job; health education, and physical training.

For many young men, the Job Corps offers the best opportunity to develop the skills and work habits necessary for finding and holding a job.

Since January 1965, when the Catoctin Job Corps Conservation Center opened in Maryland—the first in the Nation—the Department of the Interior has ex-

Beauty, one of Nature's most precious resources, abides in the Virgin Islands sunset (above) and in the leaf-laced waterfalls that abound on the slopes of Ponape (below) where women of the Trust Territory wash their clothes in a setting of rare loveliness.

© National Geographic Society—Photo by David S. Boyer—Top Photo by Winfield Parks

panded the number of centers to 38, with nearly 7,000 men between the ages of 16 and 22 enrolled.

Over 11,500 enrollees (39% from relief families) have been through the Department's Job Corps Centers. Of these, 8,050 (or 70%) took jobs, went into military service, or back to school. The average enrollee gained, for every ten months in Job Corps, 1.5 grade levels in reading and 1.8 grade levels in mathematics.

Estimated appraised value of the conservation work performed by Job Corps enrollees for the Department of the Interior was over $12 million as of May 1, 1967. Here are some of the tangible natural resource benefits:

Beautification and land management	17,865 acres
Land surveys and mapping	3,405 acres
Parking area constructed	367,272 sq. ft.
Recreational facilities	2,692 family units*
Trails cleared	73 miles
Fencing installed	7,766 miles

* *Fireplace, picnic bench-table, parking area, rest room.*

What are some of the human factors behind these and other statistics about the Job Corps? The communities where they are stationed could furnish some happy testimony. When areas of Southern Oregon, Northern California and Denver, Colo., were flooded, Job Corps enrollees performed flood relief work until residents could return to their homes and businesses. When a crop harvest crisis occurred in Grand Junction, Colo., corpsmen assisted in the orderly salvage of crops. In some centers, select fire-fighting crews have been aided materially by corpsmen in fighting forest and range fires. Disaster and emergency rescue work of Job Corps enrollees is just part of the contribution these young men are making to their country's betterment.

The work is somewhat similar to the Civilian Conservation Corps programs of the 1930's and early 1940's. Corpsmen divide their time between education and work. The work program is consistent with the missions of the Bureau of Reclamation, Bureau of Land Management, National Park Service, Bureau of Sport Fisheries and Wildlife, and the Bureau of Indian Affairs. As the CCC enrollees left behind a wealth of conservation attainments and recreational facilities as their part in building the national estate—so the Job Corps enrollees of the past two years are beginning to complete significant projects.

The CCC turned out men who filled many leadership roles in World War II and in public and private service since. The Job Corps enrollees, although such was not a specific goal, are finding their way into military service where they had not qualified before, while others are becoming involved in public or private service, much as the CCC enrollees did some 30 years ago. We are witnessing now, in the rehabilitation of Job Corps enrollees, the building of men who someday will hold significant assignments in this country.

Office of the Science Adviser

Our new age of environmental quality demands a realignment of science and technical skills, from exploitation of the land to living in harmony with the land. Living in proper balance with a nature that will feed not only our stomachs, but our souls as well, requires comprehensive planning and management in the use of landscapes and seascapes, mountains and forests, wild rivers and placid bays, and minerals and fuels.

From cave man to space man, the running battle for all mankind has been with the elements. Our engineers dam the mightiest rivers, burrow through the tallest mountains, build transports to move hundreds of people faster than the sound of the jets that propel them. This single-minded purpose—to tame nature—has paid off. By all material measures, America stands first among the nations. But like all plans and programs designed to meet limited objectives, these have had unplanned and unwanted consequences.

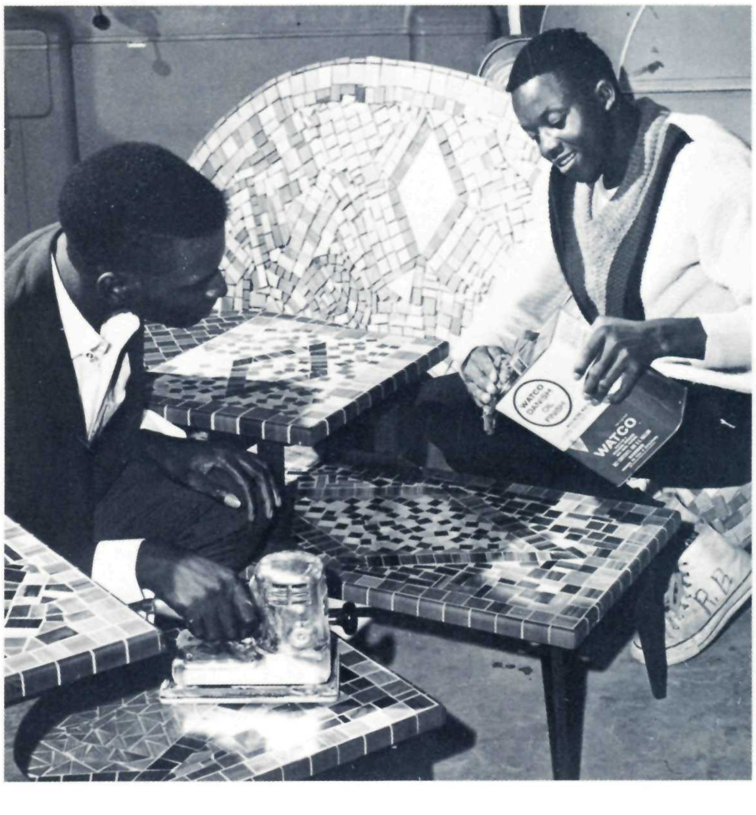
The opening of the Welland Canal to the Great Lakes brought not only ships but the sea lamprey—death to the lake trout and to the trout fishing industry. More welcome energy via steam plants is all too often measured by the amount of unwelcome air pollution produced or by fish-killing temperature increases in our rivers. Miles of river and stream made fishless and useless by acid mine water lend a dubious distinction to coal-producing states.

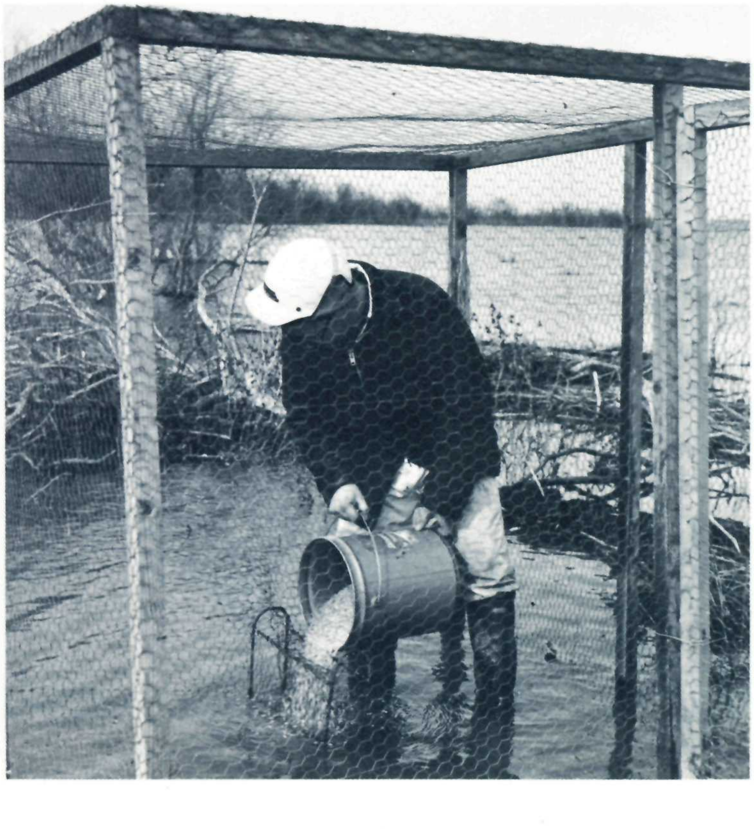
The question that science and technology now faces is: "Can we make and keep an environment beneficial to the whole man and to the whole nation?" Hopefully, the answer will be "yes." The nuclear and space ages have provided us with instruments, facilities, manpower, and know-how that can and should be applied to this age of environmental quality problems.

Careful study of Gemini photographs of our land and ocean by experts of the Geological Survey and Bureau of Commercial Fisheries has revealed structures and patterns of great significance in understanding global resources. The Earth Resources Observation Satellite (EROS) program, a joint Interior-NASA effort, will involve satellites in sun-synchronous polar orbits photographing and sensing the earth in repeated passes. They will record not only changes in natural patterns, but the man-made patterns of air and water pollution, variations in highway and park congestion, urban and suburban growth and a host of other variables, some of which change so fast we can hardly keep track, to say nothing of planning for orderly development.

The Bureau of Reclamation has a large weather modification research and development program which, if successful, may swell the ever diminishing flow in river basins like the Colorado. But as we approach weather control, how can we be sure what regions we should irrigate and which should be passed by? More

An 80-man Job Corps crew finishes planting 17,400 pine seedlings in a California burn area (above). Corpsmen from a Utah Conservation Center learn art of wood mosaics (lower left), while an Idaho Corpsmen baits a duck trap on a National Wildlife Refuge as part of a duck-banding program.





importantly, what effect will weather control have on the ecological balance of plants, wildlife and man?

These are some of the factors which shape the current and long-range goals of the Department. To provide the scientific basis for achieving these goals, the Department sponsors research on the land, water, and living resources of the nation and the surrounding oceans. Departmental efforts in these areas are coordinated by the Secretary's Science Adviser, who also maintains liaison with other federal agencies to assure that the appropriate competence of the nation's scientific community is brought to bear upon particular research problems.

Solicitor

America's environmental crisis continued to engage the ingenuity and resourcefulness of Department lawyers in their legal efforts to protect publicly owned resources and to preserve our natural environment.

Lawyers in the Office of the Solicitor helped develop approaches to conservation problems such as preservation of estuarine areas, the shaping of an oil shale technology program that will benefit the American people, protection of marine resources, and preservation and enhancement of scenic and historic areas. Interior's lawyers played important roles leading up to the Supreme Court's decision in the High Mountain Sheep case involving protection of conservation values and proper utilization of a major hydropower site, the decision in *Littell* v. *Udall* which dealt with the duties of attorneys to their Indian tribe clients under contracts for legal services, and the Secretary's decision in the Indian Hill desert land entry cases involving an attempt to acquire public land by unlawful means.

Later in the year, a series of important cases contesting the validity of mining claims on publicly owned oil shale lands was brought to trial by members of the staff of the Regional Solicitor in Denver.

Country Beautiful Magazine

"Beyond brick and mortar, away from the sound of cities . . . over the hills to God's own country . . . where health and happiness take root . . . where Nature quickens physical, mental and spiritual guidance . . ."

Congressman John P. Saylor, Pennsylvania

A REPORT TO OUR STOCKHOLDERS . . . THE AMERICAN PEOPLE • Fiscal year 1967

From the United States Department of the Interior

Funds Made Available to the Department of the Interior by U. S. Congress for Nationwide Natural Resource Programs

Land Resources

About 570 million acres of land are managed by Interior for grazing, growing timber, and recreation. Much of this land also is a vital source of oil, gas, and other basic materials that support our economy. Some is extremely rich in oil shale.

$344 Million

Fish and Wildlife Resources

Interior aids the commercial fishing industry through research and grants. It also operates wildlife refuges covering millions of acres of land and water, fights to save endangered species, and raises millions of game fish each year for stocking streams.

$133 Million

Water Resources

Interior plays a key role in wise management of our water resources for irrigation, power production, and many forms of recreation. Also, it combats pollution of streams, provides water for municipalities, builds desalting plants, and helps colleges throughout the Nation in water research.

$593 Million

Mineral and Fuel Resources

Interior's programs help speed development of essential mineral and fuel deposits by industry. Meanwhile, intensive studies in laboratories and the field help assure that our limited supplies can be stretched to meet ever-growing needs. New geologic maps constantly are being readied for use in water management and mineral development.

$153 Million

Human Resources

Interior's programs for helping people are extremely diversified. They range from an expanding school system for children on Indian reservations to the education and well-being of residents of the territories. Much also is invested in promoting the health and safety of those working in mineral and coal mines.

$275 Million

Administration-Management

Experts in the wide range of resource management and development are necessary in guiding Interior's national programs. However, emphasis is on field-level activities, and nine of every ten of Interior's employees are located outside Washington, D. C.

$11 Million

TOTAL INVESTMENTS $1.5 BILLION

Income Realized by the Department of the Interior and Returned to Taxpayers Through Local, State, and National Programs, or to U. S. Treasury

Rental Income

Bid bonuses and rentals for mineral production on the Outer Continental Shelf, and rental of other Interior-managed property, plus miscellaneous income, bring nearly $2 million daily back to the U. S. Treasury to help finance various Federal programs.

$630 Million

Water and Power Revenues

As a major producer and distributor of low-cost electricity and a builder of large irrigation works, the Department sells billions of kilowatt-hours of power every year, speeding America's growth and helping reclaim arid lands of the West. Money from power sales and from irrigation, domestic, and industrial water sales goes to the U. S. Treasury to make multipurpose projects self-liquidating.

$337 Million

Oil and Mineral Leases

Interior is a major landlord for U. S. Taxpayers. From royalties on oil, gas, sulphur, and other minerals produced from the Outer Continental Shelf – and from other royalties on public lands – millions upon millions of dollars flow regularly to the U. S. Treasury, credited to the account of the American people.

$160 Million

Operation Golden Eagle

Money from the sale of the Golden Eagle Passport and surplus Federal property, plus income from the motorboat fuel tax, is returned to the states, territories, and Puerto Rico to help buy recreation areas and plan recreation programs. Some also helps buy Federal recreation sites for the public and wildlife protection areas.

$95 Million

Grazing Fees, Timber Sales

The millions of acres of public lands managed by Interior return handsome dividends from timber sales, grazing permits, and outright sale of land. The many millions of dollars so realized each year are allocated among various states and counties for their own use and also support the Reclamation Fund.

$56 Million

Duck Stamp Sales

Duck hunting stamps and excise taxes on certain sporting equipment bring millions in revenue which is invested to provide better hunting and fishing opportunities. Some of the income also buys Federal refuge lands for public enjoyment.

$43 Million

Publications and Map Sales

Interior's scientific, technical, and popular publications and maps, reflecting all phases of its many programs, are in heavy demand by schools, colleges, libraries, and the general public because of the increasing concern with conservation. Money from the sale of maps and reports is deposited in the U. S. Treasury.

$1.4 Million

TOTAL REVENUES RETURNED $1.3 BILLION

Acknowledgments

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Interior's Conservation Yearbook Series

This Conservation Yearbook series format constitutes both the annual reports and the special reports to the nation which have been published in previous years by the Department of the Interior.

The first of the series, published in 1965, is entitled "The Quest for Quality ($1.00); the second, published in 1966, is "The Population Challenge" ($1.25); the 1967 Yearbook is "The Third Wave" ($2.00). All are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

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(Right) Hikers enjoy the stunning beauty of the North Cascades in the State of Washington. One of the most scenically spectacular in the United States, the area is being considered by Congress for national park status.

For sale by the Superintendent of Documents, U.S.
Government Printing Office, Washington, D.C. 20402.
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"The air and water grow heavier with the debris of our spectacular civilization."

PRESIDENT LYNDON B. JOHNSON
Message to The Congress on Air Pollution, Jan. 30, 1967